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# TECHNOLOGY ASSESSMENT OF PORTABLE ENERGY RDT & P

## UNIVERSITY TEAM REPORT

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Policy Alternatives  
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CENTER FOR ENERGY STUDIES



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## OVERVIEW

During the period June 17, 1974, to January 31, 1975, a TRW, Inc./University of Texas at Austin (UT) team conducted a joint study for the Special Studies Division (SSD) of the National Aeronautics and Space Administration (NASA) on "Technology Assessment of Portable Energy Research, Development, Technology and Production." The key activity of that study was a five-day Portable Energy Technology Assessment Workshop conducted at Monterey, California, during the week of August 25, 1974. Shortly thereafter, SSD received a UT report, based on comments prepared by six UT work group representatives (Appendix III.A), which described the efforts of the university team up to and including the workshop (1). This report also included brief observations about workshop activities and recommendations for improving future workshops.

In September, 1974, TRW, Inc., published a workshop proceedings report (2). On receipt of this proceedings report, the UT team organized an ad hoc committee to evaluate the results of the workshop and to suggest areas for future research. The fourteen members asked to prepare written critiques of the conference and the proceedings brought to the review process a wide variety of experience, talent, and training. A brief information sheet provided guidance to each member in the preparation of their reviews (Appendix III.B). Basically, the members were asked to comment on:

1. The suitability of the workshop objectives
2. The extent to which the objectives were achieved
3. The effectiveness of workshop methodology
4. The suitability of the choice of participants
5. The validity of workshop conclusions
6. Relevant problems not addressed in the workshop
7. Additional research needed in the portable energy area.

The members were given approximately three weeks to complete their reviews and submit written critiques. At the end of that period, the committee was assembled and the overall impact of the workshop was discussed.

As a result of these efforts, two documents were produced: a summary of critique comments with copies of the actual critiques (see Part III) and a list of thirty-four suggested research projects (see Part IV). These research topics were considered in accomplishing the major objective of the TRW/UT study: the presentation to NASA of a program for planning and research in portable energy for the remainder of the century. To simplify evaluation, these thirty-four projects were divided into five categories:

1. Methods for increasing supplies of present fuels
2. Methods for developing new fuel sources
3. Utilization of new transportation fuels
4. Initiation of improved conservation practices
5. More equitable distribution of fuel supplies.

The suitability of these research projects and others identified by TRW, Inc., and SSD were discussed at a joint conference at Moffett Field, California, on November 25, 1974. At this time each suggested project was evaluated in terms of three criteria:

1. Did it represent an area in which NASA research was needed and appropriate?
2. Was similar research already being conducted by NASA or other agencies?
3. Did NASA have "in house" or immediately available resources to conduct the research?

Based on these evaluations, the UT team was asked to prepare suitable work statements for four projects which were believed to meet each of the three criteria (Part IV). At the same time TRW was asked to prepare work statements for thirteen projects. Both university and industry teams submitted draft work statements to SSD representatives at another joint meeting on December 19, 1974, at Moffett Field, California.

#### REFERENCES

- (1) Vanston, John H., Jr., Dudley L. Poston, and W. Parker Frisbie. Portable Energy Technology Assessment Workshop, Policy Alternatives Study No. 2A, Center for Energy Studies, The University of Texas at Austin, 1974.

- (2) National Aeronautics and Space Administration, TRW, Inc.,  
The University of Texas at Austin. Portable Energy  
Technology Assessment Workshop, Proceedings Report.  
TRW, 1974.

PART I

THE ALTERNATE SCENARIO PLANNING (ASP) TECHNIQUE:  
THEORY, METHOD, AND CASES GENERATED

## A. GENERAL BACKGROUND AND THEORY

### Introduction

The continuum of time is divided into two distinct regions--the past and the future--by the constantly dynamic "now." Although physicists and philosophers may argue that the velocity of "now" is variable, no one seems to dispute its direction; this universe, at least, appears to move only forward in time. Philosophically and operationally the two temporal regions have quite different characteristics. Although scholars may dispute the meanings of past events, or even if certain reported events actually occurred, they do not deny that "a past" does exist nor that this past can be defined and described to the accuracy and exactness desired, within the limits of the evidence available. The other region of the time continuum is quite different, however. The concept of the existence of a single, unchangeable, although unforeseeable, future requires an acceptance of inevitability that most modern pragmatists find distasteful. It is often more useful to assume that not one, but a number of possible futures exists. The particular one of these futures which will actually come about will depend on various trends, decisions, and events, most of which are beyond the control of a given person or agency. This concept of the existence of a number of possible futures is the foundation for the forecasting and planning technique herein referred to as "Alternate Scenario Planning."

Planning is an essential management function of any organization. Since planning is by its nature conducted at a time different from that at which it will be carried out, a forecast must be made either

explicitly or implicitly about the economic, technical, social, ecological, and political environments that will exist as the plans are converted into actions. In other words, the manager must choose which possible future he will plan against.

The most probable future would seem to be a wise choice, if such a future can be determined. Herman Kahn and Anthony Wiener in the book The Year 2000 use this "surprise free" future as a basis of much of their analysis, although conceding that the probability of any one given future coming about is essentially zero. It would certainly not seem very wise, of course, to select a "less probable" future as a planning basis; nevertheless, the future which finally unfolds may be quite different from the one adjudged the most probable. As Professor James Bright of The University of Texas points out, most organizational plans are based on a future "about like the present, but a little better for us"<sup>(1)</sup>.

Alternate Scenario Planning eliminates the manager's difficulty in choosing the proper future on which to base his plans by providing a method for allowing a spectrum of possible futures to be taken into account during the planning process.

#### Overview of Method

In essence, the ASP technique involves the development of a series of possible sequences of future events, i.e., scenarios which might effect the organization's prospects, policy, and programs. (Some authors associate the term "scenario" with some single event in the future; however, in this paper the term will be used to describe a series of related events, trends, and



developments listed in a logical, roughly chronological, sequence.) Once these scenarios have been produced, a plan is developed which optimizes organizational prospects for each of the projected futures. These separate plans are then evaluated to determine similarities and differences. After evaluating the probability that each scenario will approximate future events, an overall plan is developed which effectively accommodates as broad a range of scenarios as possible, while giving consideration to the relative probabilities of each actually occurring. Finally, procedures are established for monitoring future events and trends to assist in determining proper actions by the organization.

#### Scenario Generation

Scenarios can be generated in a number of ways with the method chosen depending on the use to be made of the scenario, the nature of the organization, and the personal preference of the planning group involved. Examples of scenario generation techniques include the following:

1. Kahn and Wiener have sought to develop scenarios by assembling committees made up of persons with a great deal of knowledge and imagination, usually in broad general areas<sup>(2)</sup>. By having these people investigate, analyze, and evaluate past trends, an attempt is made to project what might reasonably be expected in the future.
2. Abt Associates have used computers to prepare scenarios for the U.S. Air Force based on postulated actions that certain countries or groups of countries might take in various circumstances<sup>(3)</sup>. Specific scenarios are based on random selection from the various alternatives possible. This technique has also been used to generate non-military scenarios.

3. Forrester and Meadows in the "Club of Rome" project on the future of man have sought to develop a computer model of all the major factors affecting mankind(4). The model is characterized by a relatively simple simulation of cause-effect relationships and a complex system of feedback loops.
4. Bright and Vanston have sought to develop alternate scenarios by examining relevant current literature, evaluating news items, and conferring with knowledgeable people(5). Based on this information they postulate related sequences of trends and events which might come about as the result of credible developments in five relevant environments (technological, economic, social, political, and ecological) and in internal and competitive company operations.

Regardless of the method of generation, each scenario should have the following general characteristics. It should:

1. Be plausible
2. Be self-consistent
3. Include all critical, relevant factors
4. Roughly parallel other scenarios in form and scope.

The scenarios for this project were developed using a variation of the Bright-Vanston technique. Details of the methodology employed are described in Part II of this paper.

#### Alternate Scenario Planning

Just as there are a number of methods for developing scenarios, there are many ways the resulting scenarios can be used. In Alternate Scenario Planning each scenario is treated separately, and the strategy best suited to meet the trends and events outlined in that scenario is developed. If practical, a different individual or planning group should be responsible for preparing the strategy for each scenario. When these strategies or plans have been completed, a joint meeting should be held at which each planning group explains

the nature of its scenario. Those actions which are similar for all scenarios should be presented, and those areas in which the actions to be taken vary with the scenario should be analyzed. Next, an overall plan is drawn up which will reasonably accommodate as wide a range of scenarios as possible. Consideration must be given to the probability of a given scenario actually coming about; however, events should not be dropped from consideration merely because they are deemed unlikely. It is quite possible that the best overall plan will not be the one that best accommodates the most likely future. Obviously, however, the plan developed must adequately address that alternative.

#### Follow-Up Action

After the composite plan of action has been developed, a coordinated system should be drawn up for monitoring the nature, direction, and importance of emerging trends and for searching for possible causes of important events. This system should be as specific as possible in identifying responsible monitoring agencies, reporting procedures, and critical points in trend development. The whole purpose of the ASP exercise is to aid the organization in taking advantage of emerging opportunities and to protect itself against future threats. An effective monitoring program is essential to meeting these goals.

#### Advantages of Alternate Scenario Planning

The techniques associated with the alternate scenario approach to planning do not constitute a new method of forecasting, but, rather, provide a means of using forecasts produced by other

techniques. The advantages of this approach include:

1. It forces planners to accept and act on the fact that the future can never be exactly known. Thus, the plans resulting from the use of this technique should involve more flexibility than those drawn up to meet one set of postulated events.
2. It serves as a tool for communication between people with very different points of view and encourages cross-fertilization of ideas.
3. It provides a vehicle for integrating the myriad of relevant technical and non-technical factors into the planning process.
4. It encourages the development of a structured system for monitoring trends and events of import to the organization. Thus, it aids in preventing the organization from being faced with unexpected threats and from failing to take advantage of emerging opportunities.
5. It helps to identify the point at which important decisions will have to be made in the future. This should allow more time for consideration and data acquisition.

In short, Alternate Scenario Planning can provide assistance to many organizations and agencies in effectively planning to meet a variety of possible futures, as well as in developing future-oriented thinkers.

## B. METHOD OF GENERATION

### Introduction

Developing scenarios which will be of material value in Alternate Scenario Planning is, at best, an uncertain art. Because of the amount of time required for careful employment of this technique, it is most important that the scenarios be relevant, thought provoking, and comprehensive. However, because of the recent advent of this approach to planning, methodologies for scenarios production are just now being developed. However, the stepwise methods described below have proven to be useful in previous ASP applications used by Bright and Vanston<sup>(6)</sup>.

### Steps in Alternate Scenario Development

1. Define purpose and organize development team. The first step in developing a set of alternate scenarios is to determine the purpose and goals of the ASP effort, the scope of the project, and the time available for the conduct of the exercise. The nature and detail of the scenarios will, in large part, be determined not only by the time and resources available for preparation but often, more importantly, by the time and level of effort that will be allotted to carrying out the planning activities. During this objective-definition stage the team which will actually prepare the scenarios should be identified and organized. Although the exact number and type of people involved in accomplishing this task will depend on the available resources, it is desirable that at least two or three people be involved to encourage cross-fertilization of ideas. The scenario preparation team should include people with evident imagination and with a wide variety of backgrounds, talents, and specialties.
2. Gather relevant data. Early in the preparation process the collection of data bearing on the areas to be forecast should be started. Again, the nature and scope of this data base will depend on the time and resources available. However, the acceptability and effectiveness of the scenarios will depend, in large measure, on the credibility and completeness of the data base. Since scenarios

usually involve a number of societal factors, a large amount of background material may be necessary; thus, a logical, efficient system for data collection, correlation, filling, and recovery is necessary.

3. List all relevant factors. A careful definition of the purpose and scope of the ASP exercise will assist in identifying those factors in the social, political, economic, technical, and ecological environments that will be relevant to the project. At this stage broad license should be allowed in factor identification. Often, items that seem to be only peripherally germane to the subject at hand turn out to be of great importance on closer examination.
4. Determine the most pertinent factors. It is probable that many more factors will be identified in the previous step than can be specifically addressed in the actual scenarios. Therefore, a winnowing process is necessary to reduce the number of factors to be considered to a manageable number of the most important. If possible, knowledgeable people other than the scenario writers should assist in this factor-weighting exercise. In fact, the inclusion of management personnel in this step of the preparation will not only improve the quality of the scenarios, but will also increase their understanding and acceptance of the ASP technique.
5. Choose themes for alternate scenarios. Since the number of factors that might be considered in a scenario is very large and since the range of values for each factor is continuous, there is a double infinity of possible futures that might be addressed. The team can plan only against a finite, generally small, number of futures. Although the exact number of scenarios to be developed will depend on the particulars of circumstances, experience has shown that from three to seven are usually adequate. As will be discussed later, one of the scenarios should be the one that is believed to be the most probable, the "centrario." The other scenarios should be chosen on the criterion of maximum value to the planning process. Because of the limited number that can be accommodated, the alternate scenarios should address futures that are important to the organization, that are different in nature from one another, and that tend to bound the spectrum of futures that might affect the organization's well-being. For the last reason these bounding scenarios are sometimes called "boundarios."

The simplest set of boundarios would be two that described a future remarkably fortuitous for the organization yet

dreadfully unfortunate. For most purposes this matrix is probably too simplistic to be of much value. Thus, the scenario production team is faced with the problem of choosing themes around which the projected futures will be developed. The choice of this set of pertinent, basically orthogonal, boundaries represents one of the most important steps in the development procedures. This is another point at which liaison with the organizational management may be of major value.

6. Arrange factors into related groups. Once themes have been determined, the factors chosen in Step 4 should be gathered into related groups. The theme of each of the boundaries will indicate which of the factors in the scenario should be changed. Since many of the key factors will be interrelated, the effects of changes in one factor on others can be more easily considered if related factors are properly grouped. At this point some may be dropped and others added. However, it must be stressed that all factors considered in one scenario must be considered in all.
7. Define present situation in terms of the chosen factors. Using information on the status at present and in the recent past of the previously chosen factors, write a narrative statement of the present state of the relevant society and how this state came into being. This statement should be a short, coordinated history of important events, occurrences, and trends that have resulted in the present status. Factual material should be carefully documented and referenced; technical and obscure terms should be defined; trends should be displayed graphically when practical. This background report will not only serve as a starting point for scenario development, but will also serve as a means of bringing participants in the ASP planning effort to a common starting point and will minimize unprofitable quibbling about factual material.
8. Develop scenario. The people preparing the scenarios must now begin to project their evaluations of what the future most probably holds in the areas being considered. For this purpose they may use the projections of others, their own forecasts, or most often a combination of the two. They may use any of the common forecasting techniques—e.g., Delphi, normative forecasting, or computer simulation—or any other techniques that they desire. Since all forecasting techniques are, in reality, based on trend extrapolation modified by personal judgments, the scenario writers might well use the data assembled in Step 5 as the basis for trend projections. Regardless of the method used, the development team must be prepared to defend the data on which their forecasts are based and to explain

the logic of their methodology.

Once projections for each of the factors have been determined, they must be compared for consistency, and a narrative or correlated description of the postulated "most probable" future, i.e., a centrario, must be prepared. Although this scenario will probably be used to describe one or more points in time, i.e., future "snapshots," transitional material explaining how given situations developed during relevant time intervals will increase clarity and acceptability. Where possible, pertinent references should be listed. Although reasonable brevity is desirable since this scenario may be used as a basis for planning, a careful explanation of basic reasoning should be given, as the centrario will serve as the basis for the development of all other scenarios.

9. Alter basic factors to support boundarios. Once the centrario has been completed, the most probable projected values of the basic factors should be reexamined to see how they might be changed if the boundaries prescribed by the alternate scenario themes were to come about. Each theme should be considered separately, with appropriate factor changes being made individually at first and later examined, in mass, for consistency. Changes in factor values should be significant but within the range of feasibility, i.e., factors should be altered to the point where further changes would no longer result in different organizational actions. The changes in all appropriate factors taken collectively should outline a future which closely follows the chosen theme.
10. Prepare boundarios. This step involves the production of a series of scenarios similar to that produced in Step 8. In fact, care should be taken to assure that all scenarios are as closely alike in format, wording, and style as practical. This parallelism will assist in comparison of the separate planning results. As with the centrario, projections should be referenced, if possible, and the reasoning carefully explained. Also, intervening events should be included to support and explain snapshot descriptions of the future. In some cases, it may be desirable to include important possible but improbable events in these scenarios. However, this should be done with care and only where a specific purpose is thereby served.
11. Check all scenarios for consistency, clarity, and completeness. It is very easy in a complex scenario to overlook internal inconsistencies and normally obvious violations of logic and reason. All scenarios should be checked by



people not involved in their preparation to insure that they are clear, comprehensible, and free of errors. When possible, it is highly desirable for the entire ASP exercise to be simulated by an outside agency. Such a trial run may well point up methods of improving the planning operation.

12. Modify scenarios as necessary and organize for use. After the scenarios have been reviewed for clarity and accuracy, the final version of the scenario should be prepared and all materials organized for effective utilization during the planning exercise. The exact organization and presentation plan will, of course, depend on the use to which the material is to be placed.

#### Development of Scenarios for the Portable Energy Technology Assessment Workshop

The scenarios used for the Portable Energy Technology Assessment Workshop were developed using techniques very similar to those outlined above. Some modifications were made because of the shortage of time available for development, particular contract requirements, and personal preferences. Specific actions are taken in this operation as described below. The numbers of the listed steps correspond with those given in the previous section of this report.

1. The general purpose of the workshop and the proposed use of the scenarios to be developed by The University of Texas (UT) team were outlined in the original NASA Work Statement. Subsequent meetings of UT, TRW, and NASA representatives further defined the desired nature of the scenarios and the methods by which the scenarios would be integrated into the workshop procedures. It was agreed that approximately six different scenarios would be prepared, that they would average seven to ten typed pages in length, and that they would stress non-technical aspects of the energy problem. Each scenario would portray a projected overall picture of the society of the United States in the years 1985 and 1995. The purpose of the scenarios would be to describe the driving forces which will determine the demand for various energy forms in the years in question and to identify the constraints on possible solutions to future energy problems. It

was agreed that the UT and TRW teams would jointly translate scenario factors into appropriate tables of demand.

The scenario development team was composed of three UT faculty members and three UT graduate students. One faculty member was from the Department of Mechanical Engineering, while the rest of the team members were sociologists with research specializations in demography and human ecology. This apparent imbalance reflected the emphasis in the work statement on non-technical input from the university team. Each scenario was reviewed by a team of evaluators representing a variety of technical and non-technical disciplines.

Although not a direct part of the scenario development effort, a table of possible actions was prepared by the industry team to aid non-technically oriented participants in understanding the implications of various technical alternatives.

2. Gather relevant data. Because the contract work statement for the university team emphasized non-technical aspects of the energy problem, the scenario development committee focused most of their data-gathering activities on non-technical areas. Current "futures" literature received particular emphasis as well as data on societal dimensions and demographic trends. Committee members spent approximately two weeks familiarizing themselves with relevant material before moving to the next step. A bibliography of some of the references used in data accumulation is given in Section E.
3. List all relevant factors. Based on the information gathered in Step 2, the committee next listed all components of the social structure which could reasonably be associated with energy consumption or which would limit or restrict the production of energy. All relevant factors were listed even though in some cases their impact on the energy status appeared somewhat remote. In all, approximately ninety factors were identified. These factors are given in Appendix I.A.

4. Determine the most pertinent factors. Because the number of factors identified in Step 3 was too large to be considered in scenarios of a practical length, it was necessary to choose those that would be most important to the accomplishment of workshop objectives. At this point three additional consultants were engaged to assist in factor evaluation. These consultants included an economist, a sociologist, and a political policy scientist. After a general meeting of the committee with the consultants, members of both groups were asked to rank the factors in order of their importance to the energy status of the nation. An analysis of these evaluations indicated close agreement among all members of both groups. Based on these evaluations thirty-nine were chosen for inclusion in the scenario act. These factors are listed in Appendix I.B. It will be noted that some new factors were indentified during this activity.
5. Choose themes for alternate scenarios. The committee next set about determining a set of scenario themes which would effectively bound the range of feasible futures that the nation might face. Because of the complexity of the problems being addressed by the workshop, it was obvious that a great deal of care would be required in the choice of scenario themes. Because of the overall organization of the workshop it was determined that the number of scenarios to be considered would be limited to six. After considerable deliberation within the committee, together with consultation with the NASA and industry teams, the six bounding themes were identified. The themes chosen were as follows:
  - a. A future in which the nation puts primary emphasis on economic expansion, increased production, and improved material well-being.
  - b. A future in which the nation puts major emphasis on environmental and ecological improvement even, if necessary, at the expense of other factors.
  - c. A future in which the government takes strong action to stress social and economic equality.
  - d. A future in which the nation is faced with major economic trauma.
  - e. A future in which major technological breakthroughs increase the efficiency of energy usage (This future did not consider advances in energy production technologies since increases in research and development in those areas represented potential actions available to the planners).

f. A future in which international tension is markedly increased and the United States adopts (or is forced to adopt) an isolationist policy.

The inclusion of the most probable scenario in the set was considered but was rejected because it was felt that all six bounding themes were necessary for a thorough consideration of the energy problem. It also appeared probable that the work groups at that workshop would wish to develop their own most probable scenario in Phase II deliberations.

6. Arrange factors into related group. After comparing the factors developed in Step 4 with the six chosen themes, it was decided that the factors should be grouped into nine general topics.

- |                    |                                    |
|--------------------|------------------------------------|
| a. Population      | f. Transportation                  |
| b. Urbanization    | g. Education                       |
| c. Labor force     | h. Values and Environmental Policy |
| d. The economy     | i. The international situation     |
| e. Social equality |                                    |

7. Define present situation in terms of the chosen factors. At this time the scenario development committee prepared a narrative description of the present status and recent history of the United States based on the factors determined in Step 4. All listed data were carefully referenced and a glossary of terms was attached. This background information was made available to all participants at the beginning of the workshop. (Distribution to participants prior to the workshop would have been preferable.) A copy of this description is attached as Appendix I.C.
8. Develop centrario. After consultation with the NASA and industry teams, it was decided that the scenarios would focus on two points in time, the years 1985 and 1995. To begin the development process, values were assigned to each of relevant factors. The values were carefully chosen after comparing estimates from various technical and "futures" sources with trend extrapolations developed by the committee itself. These values were then integrated into a narrative description of the societal environment that was envisioned for the two chosen years. The committee next worked with the TRW team to develop specific fuel demand figures for each of the two relevant years. A listing of factor values used is given in Appendix I.D and Section C is a copy of the centrario.
9. Alter basic factors to support boundarios. The scenario development committee next examined each of the relevant factors and determined how they might be affected by the futures envisioned in the six alternative themes. When appropriate, factors were modified to reflect projected

effects. Initially, each factor was considered separately within a single theme. In general, changes were made as large as reasonable; however, to the extent possible, these changes were based on substantiating data. For example, in changing the growth rate predictions, the limits chosen were the highest and lowest projections published by the Bureau of Census. Once the individual factors had been changed, the list of modified factors were considered as a group to take into account the impact of changes in one factor on the others. When necessary, factors were again modified to insure a self-consistent set. The process was then repeated for each theme. The factors developed for all boundarios are shown in Appendix I.D.

10. Prepare boundarios. Using the modified factor values developed in Step 9, scenarios were developed for each bounding theme. The time frames described were the same as for the centrario, i.e., 1985 and 1995. To the extent possible, each boundario had the same format and, in many cases, the same phrasing as the centrario. This parallelism was sought to facilitate comparison of the plans during the second phase of the planning effort. In collaboration with the TRW team, the committee then analyzed how the factor alterations would effect fuel demand, and new demand tables were prepared for each alternate scenario. Brief resumes of boundarios are listed in Section C. Copies of the completed boundarios are included in the TRW workshop report.
11. Check all scenarios for consistency, clarity, and completeness. The completed scenarios were then sent to two editors for review and rewrite as necessary. Copies were also sent to selected consultants for suggestions and comments. After suggested improvements had been incorporated in the scenarios, a workshop "trial run" was conducted using University of Texas graduate students as participants and UT team members as monitors. The students were asked to prepare oral reports similar to those expected from the workshop groups. They also were asked to note errors, confusing diction, and general weaknesses in the scenarios and to comment on the ASP technique. The results of this trial run are discussed in Section III of this report.
12. Modify scenarios and organize for use. The comments of the trial run participants were carefully weighed and scenarios altered as appropriate. A final review of scenarios was made by the committee and final typing completed. The scenarios and supporting data were then forwarded to TRW for inclusion in the workshop notebooks to be sent to the participants. Each participant received a copy of the boundario for his work group only.

FOOTNOTES

<sup>1</sup>J.R. Bright, A Guide to Practical Forecasting (Englewood Cliffs, N.J.: Prentice Hall, 1973), pp. 10-1 to 10-32.

<sup>2</sup>H. Kahn and A. Weiner, The Year 2000 (New York: Macmillan Co., 1967).

<sup>3</sup>Bright, pp. 191-214.

<sup>4</sup>D.L. Meadows et al, Limits to Growth.

<sup>5</sup>J.R. Bright, A Brief Introduction to Technology Forecasting (Austin, Texas: Pemaquid Press, 1972).

<sup>6</sup>A number of the concepts included in this report were originally suggested by Mr. Ralph Lenz, Advanced Systems Planning, U.S. Air Force, and Mr. Clyde Simmonds, Canadian National Research Council.

## C. CASES GENERATED

Centrario (Most Likely Scenario)1. Population

- a. The fertility rates began declining in the 1960's, and the decline gained some momentum in the 1970's (the General Fertility Rates, i.e., annual births per 1000 females aged 15-44, dropped from 87.4 in 1970 to 81.9 in 1971, and to 73.4 in 1972).<sup>1</sup> This trend continued but at a more moderate pace. Although the average annual births remained below the replacement level throughout the last quarter of the 20th century (1.9 births per 1000 women of childbearing age in 1985 and 1.8 in 1995), the population continued to grow due to the relatively large number of females of prime childbearing ages. (1957 was the peak of the post-war "baby boom," and the 1957 cohort reached age 20 in 1977.) Stationarity (constancy in size and age distribution) was predicted to occur within the first third of the 21st century.
- b. The 1985 Current Population Survey estimated the population to be 231 million (including immigrants). This was a 12.7 percent increase over the 1970 total of 205 million and approached the "medium" Census Bureau projections. By 1995, the United States population was 246 million, a 6.5 percent increase. Average family size was 3.5 in the 1980's and close to 3.2 in the 1990's.
- c. Increasingly effective contraception (male as well as female) and the growing acceptance of abortion indicated that Zero Population Growth (ZPG) and a stationary population were likely to occur by the 21st century. Although overshadowed by declining fertility, the infant mortality rate declined notably from the 1970 level of near 20 deaths per 1000 live births (which placed the U.S. low compared with other developed countries) to 17 deaths in 1985 and 15 deaths in 1995. This accomplishment was due partly to improvement in the socioeconomic conditions of the black and Spanish-surname populations. Compared to the 1970 figures, life expectancy at birth was increased by about 2 years (to 72) by 1985, and by 3 years (to 75) by 1995. The reasons for this improvement were several. Deaths from cancer were reduced by one half as rates of remissions grew, largely the result of new methods of early diagnosis. The spectrotherm infrared scanning unit for detection of tumors, which had appeared by 1974, was improved and utilized more widely. (This detection device gave women with breast cancer a 75%

greater probability of survival.) Computer-assisted diagnosis of a number of diseases, including early signs of susceptibility to cardiovascular ailments, plus advances in methods of treatment, reduced the number of deaths due to heart failure, stroke, arteriosclerosis, etc.

- d. The life expectancy of black population increased due to an improved standard of living. (The potential for improvement in this area was evidenced by the 7 year gap in life expectancy between blacks and whites in 1970, which was narrowed to 4 years by 1995.) Fertility rates for black and Spanish-surname populations declined somewhat more slowly than for Anglos. The result was an increasing proportion of the total births which were births to women of these two minority groups. Consequently, the proportion of the population that was black had increased from 11% (22.7 million) in 1972 to 11.5% (26.6 million) by 1985 and to 11.9% (29.3 million) by 1995. The Spanish-surname population comprised 4.4% (9.2 million) in 1985 and 5.5% (13.5 million) in 1995. The comparatively high birth rate of the Mexican-American component of the Spanish-surname population and continued immigration from Mexico accounted for the most substantial portion of the growth of the latter group.

## 2. Urbanization

- a. The "metropolitan explosion" persisted between 1970 and the turn of the millennium. The rate<sup>2</sup> was reduced, however, since (1) movement out of agriculture was virtually complete by the early 1970's when about 4% of the labor force was engaged in the primary sector and (2) immigration restrictions were placed on Western Hemisphere countries in the mid 1960's. Metropolitan areas captured 83% of the growth from 1960 to 1970; the number of metropolitan residents increased from 119.6 million to 139.4 million.<sup>3</sup> During the 30 years between 1970 and 2000, the proportionate share of metropolitan growth stabilized at slightly over 80%. This meant that the Standard Metropolitan Statistical Area (SMSA) proportion of the total was 70% in both 1985 and 1995. The urban population displayed a similar trend and comprised the following percentages of the total population: 77% (178 million) in 1985 and 80% (197 million) in 1995. The rural population, by 1995, had fallen some 6.5% from its 1970 level.
- b. Peripheral sprawl was the dominant form of urban growth. The return flow from the suburbs to a few refurbished



central city neighborhoods provided only a modest counterbalance to the largely uncontrolled suburban growth. In 1970, of the 68% overall SMSA population, 37% lived in fringe areas, and the remaining 31% lived in central cities.<sup>4</sup> By 1985, 40% were suburbanites; in 1995 the figure was 43%. The lack of control over expansion was due to two basic factors. The first of these was the fact that the construction of New Towns did not provide a viable alternative to sprawl. The vast sums of money required for construction of New Cities (a large proportion of which is nonrecoverable) held development to a minimum. The initial operation of New Towns turned out to be highly inefficient and costly because facilities had to be constructed long before future inhabitants arrived. In addition, the process duplicated facilities already available in existing cities (e.g., public buildings, cultural centers, utilities, transportation facilities, and business firms). The second factor was the persistence of certain deep-running American institutional values. It was recognized that a comprehensive program that would effectively halt, or possibly reverse, urban sprawl would entail a severe modification of the American ideal of "privatism," a value that has pervaded the development of the country from its inception. It also became apparent that an end to urban sprawl would require the demise of such fundamental values as "local control over land-use and zoning ordinances, local financing for schools...and the ability of individual landowners to engage in real estate speculation."<sup>5</sup> The slowness with which values change, compared to the fast pace of technological and economic change, long ago noted by Ogburn, was again validated. One important result of the peripheral sprawl pattern was the extension of the "megalopolization" of areas in the Northeast (Washington to Boston), Midwest (Chicago to Pittsburgh), and West (Los Angeles to San Diego, San Francisco to San Jose).<sup>6</sup> Almost 25% of the total population was living in these areas by 1995.

- c. The proportion of blacks who were central city residents remained fairly constant at about 75% of the total black SMSA population (compared to around 40% for whites). Thus, a sizable percentage of the black labor force found it necessary to commute outward to the periphery of the cities where the bulk of new jobs were available.
- d. The reduction of multiplicity in the form of autonomous and semi-autonomous public agencies was one mitigating trend which emerged as a growing number of SMSA's opted

for the institution of metropolitan authorities. Assuming 100 as an index of the number of pan metropolitan entities with 1971 as the base year, the value increased to 175 in 1985 and 275 in 1995.<sup>7</sup> This centralization of control and coordination mechanisms was a necessary adjunct to increasing scale and complexity (functional differentiation and interdependency in organization) at both community and formal organizational levels.

### 3. Labor Force

- a. Transformation to the service sector was so far advanced by the early 1970's that the tertiary sector accounted for more than half of America's GNP and absorbed 60% of the labor force.<sup>8</sup> By 1985, the proportion of the labor force engaged in the provision of services leveled off at about 70%. The trend toward a service economy resulted in significant socioeconomic changes; among them, two had most important consequences. After the earlier transformative stage, the service oriented economy (1) evidenced a slowing of productivity (GNP per capita, because output grows faster in the production of goods than in services, and (2) proved fertile ground for inflation because labor costs of production in services are about 60-70% as compared to 30% in goods production industry.
- b. Accompanying the emergence of a service economy is expansion of the professional, technical, and clerical occupational categories.<sup>9</sup> Hence, the number of workers in white-collar jobs tended to advance while the number of blue-collar jobs declined. In 1970, the ratio of white-collar workers to blue-collar workers was on the order of 5 to 4.<sup>10</sup> In the 1980's and 1990's, the ratio was 5.5 to 4, with white-collar workers making up 50% of the labor force in 1985 and 52% in 1995. This trend influenced transportation needs in terms of the length of the journey to work. (For example, for white employees the average work-trip distance is 3 miles for laborers and 7 miles for professionals.<sup>11</sup> The reverse applies to black workers, but blacks comprise only a small percentage of the economically active population.)
- c. In conjunction with the proportional reduction of the blue-collar labor force, average length of work week declined from 38 hours in 1971 to 35 hours in 1985, and to 32 hours by 1995. This would suggest decreasing energy consumption. Moreover, although most service industries are low energy consumers (with transportation a notable exception), the slowing of increase in energy consumption,

which some scholars predicted to result from the shift to a service economy, failed to materialize. As service-bound manpower was replaced by mechanical means of production, the extractive and transformative sectors required larger energy resources. Labor-saving technology, for the most part, was high energy consuming technology.

- d. The declining demand for low-skilled labor was related to an upswing in the unemployment rates from 4.2% in 1985 to 5.2% in 1995.

#### 4. The Economy

- a. "Privatism" continued to be the leit-motif of the economic structure of the U.S., although the degrees of freedom of large conglomerates were modestly reduced by governmental regulations. The effort was intended to slow the inflationary spiral and to find solutions to energy shortages, while simultaneously providing minimal protection of the natural environment.
- b. The Gross National Product of the United States, which was \$1,152 billion in 1972, reached \$1,500 billion in 1985 and \$2,200 billion in 1995. Per capita GNP for 1985 and 1995 was \$6,500 and \$9,000 respectively. In the period from 1972 to 1985, the U.S. growth in productivity dropped to an average rate of 2.3% per annum, and thus fell behind other developed countries. During the 1985-1995 interval, productivity was again rising, averaging 4.6% per annum. Therefore, the overall average increase was near 4.0% for the years 1972-1995. GNP is an especially significant consideration inasmuch as "historically, energy consumption in the United States has closely paralleled the growth in real GNP."<sup>13</sup> The secular trend from 1920 through 1970 was one of diminished energy consumption for each GNP dollar expended. For example, in 1920, energy consumption (in thousand Btu units) was 141.3 per \$1 of GNP. The value fell to 96.1 in 1950 and 95.0 in 1970.<sup>14</sup> The latter figure was up from 87.1 in 1960 and thus represents a deviation from the historical trend. However, because of the transformation to services and rising energy prices, the long-term pattern was preserved in the 1970-1985 interval when energy consumption per GNP dollar varied around 92,000 Btu's. By 1995, an upward shift similar to that recorded between 1960 and 1970 occurred so that the average value again approached 95,000 Btu's.

- c. Although the growth rate of the U.S. lagged behind that of a number of developed countries, the economic position of the nation did not deteriorate substantially. The "real" productivity of the U.S. was greater than was apparent on the basis of the per capita GNP index. In fact, GNP became increasingly less valid as a measure of productivity since it tends to undervalue the effort directed toward the production of services as well as the production of knowledge.<sup>15</sup> Perhaps more relevant than GNP per capita was the efficiency of production as measured by the ratio of GNP dollars to horsepower in prime movers. (A prime mover is a machine that converts food, fuel, or force to work or power.) In other words, how many GNP dollars are generated per horsepower of installed prime mover capacity? The secular efficiency trend indexed in this manner indicated that the amount of gain doubled in the course of the last half of the twentieth century.<sup>16</sup> Since efficiency of production depends on the degree to which prime movers are fully utilized as well as on efficiency of energy conversion itself, substantial efforts were made to use prime movers at a level approaching peak capacity in the 1980's and 1990's through the initiation of round-the-clock shift work in industries which previously had operated on a standard eight-hour work day.

## 5. Social Equality

- a. The goal of social equality came closer to realization during the last quarter of the 20th century. The proportion of American families with incomes of less than \$3000 declined as follows: 1970: 7%; 1985: 4%; 1994: 3%. Median family income for whites was \$14,300 in 1985 and \$16,300 in 1995. Comparable figures for black families were \$11,500 and \$14,000.
- b. Income also came to be somewhat more evenly distributed. Whereas in 1970 the top quintile received 45% of the national income, the same proportion of the population received approximately 42% of the total in 1985 and 1995. The portion received by the bottom quintile rose from 5% in 1970 to 7% in 1985 and 10% in 1995.
- c. One of the brighter spots in the economic picture as the U.S. approached the year 2000 was a narrowing of the white/black income gap. For the country as a whole, the proportion of white median family income that equalled black median family income had fluctuated around 60% in the 1960's. A notable ascent for blacks brought the figure to 80% by 1985 and to about 86% by 1995. In essence, this upgrading involved the South

and the older black population catching up with the rest of the nation. In 1971, outside the South, black families with both husband and wife present and headed by someone under age 35, earned 93% of comparable white income. If both husband and wife were employed, their earnings were 105% of that for whites.

## 6. Transportation

- a. From 1950 to 1970, energy consumption per passenger mile consistently increased as greater reliance was placed on the least efficient carriers. Air travel, by far the least efficient means of travel, captured an increasing share of the intercity transportation market (4% in 1950 to 9% in 1970). Automobiles, the second least efficient mode, accounted for 88% of all intercity passenger miles in 1970. In the area of intracity transportation, 94% of all passenger miles were travelled by auto in 1970, and the use of mass transit had been declining rapidly (e.g., mass transit's share of total intracity passenger miles had dropped from 31% in 1950 to 6% by 1970).<sup>17</sup> Because of the energy shortages after 1970, some modification of these trends in the direction of energy conservation was effected. More efficient movement over space took the form of shifted emphasis on various modes of transportation, as shown by increased interurban passenger transport by rail due to government support (Amtrak). Also, the railroad's share of the freight transport market, which had dropped from 60 to 40% of the total between 1940 and 1970, grew again, reaching 46% in 1985 and 50% by 1995. Urban mass transit recaptured part of the 1950-1970 loss. It accounted for 12% of all intracity passenger miles in 1985, and 17% in 1995. Compared to the situation in 1970, energy conserved due to shifts in modes of transportation was 4% in 1985 and 5% in 1995.
- b. Other obvious energy saving alternatives in transportation began to be utilized. In particular, small cars with small engines began to replace large cars with large engines. Moreover, improved management of traffic flow was accomplished in a few major cities with the implementation of various types of electronic sensing devices (some of which were already in limited operation by 1973-1974). Energy savings from more efficient use of transportation facilities totaled 10% (Btu's) by 1985 and 15% by 1995.

- c. The expansion of the electronics/computer revolution made possible small savings in energy consumption as certain communications facilities emerged as viable functional substitutes for transportation. It became technologically possible to conduct a number of activities which formerly required leaving home (working, shopping, banking, schooling, voting) at place of residence. Although it was not feasible before the year 2000 to construct the vast interlocking communications networks mandatory for full realization of such a system, a few large business enterprises began to avail themselves further of the communications alternative to transportation. As early as 1985, 7% of the activities that previously could be accomplished only by travelling outside the local area were done electronically. By 1995, this proportion had doubled to 14%.
- d. Innovations in aircraft technology raised the efficiency level of air transport. Improved methods of cooling and the introduction of high-temperature materials allowed engines to operate at higher temperatures, thus lowering fuel consumption. Lighter, yet stronger, structural materials permitted an increase in the payload/carrier-weight ratio. Payload capacity climbed from less than 20% of the total weight in 1970 to 25% and 35% in 1985 and 1995 respectively.<sup>18</sup> As a consequence, air carriers began to carve out a larger share of the freight shipment market at the expense of rail and truck lines.

## 7. Education

- a. A direct consequence of the low fertility rate which characterized the last third of the century in the United States was decline in school enrollment. The 1960's suffered the brunt of the 1950's "baby boom"; 1967 was the peak year for number of children reaching school age. The rapid growth of school enrollment during this period was one of the primary factors responsible for elevating the percentage of GNP spent on education from 5.4% in 1960 to 7.5% in 1970. (Other factors involved were increased teacher wages and teacher-pupil ratios.)<sup>19</sup> After 1967, school enrollment was 36.6 million and declining; this figure fell to a low of 31.5 million by 1980. However, the effect of the "baby boom echo" resulted in a mild upswing, with a 1985 enrollment figure of 33.6 million and a peak of 37.1 million in 1995 followed by a gradual decline in enrollment.<sup>20</sup> Although the percent of GNP spent on education reached its highest level during the 1960-1970 period, subsequent lower enrollment

figures allowed high quality schooling with a comparatively small proportion of GNP spent on education. By 1985, 8.1% of the GNP was spent on education with only a slight increase by 1995.<sup>21</sup>

- b. Several important changes in education occurred during this period. The increasing recognition of the importance of prekindergarten instruction resulted in an increase of the number of 3 to 5 year olds attending School. This figure rose from 1.0 million in 1970 to 7.1 million in 1985 and to 11.2 million in 1995.<sup>22</sup> Another change was the increased use of low-cost instructional television and computer-aided instruction at all levels of education from prekindergarten to college. In 1971, 2% of college teaching was provided in the form of computer-aided instruction; by 1985 this had increased to 15%, and to 20% by 1995.<sup>23</sup> As the use of instructional television and computer-aided instruction expanded, these methods became increasingly cost-effective, and a growing number of students were able to take courses and earn degrees while physically removed from the classroom. This increased flexibility permitted "students" to hold full-time jobs while earning college credits and degrees at home. As the number of two-year, degree granting community colleges increased, so did the number of college graduates entering the labor market two years earlier than had traditionally been the case.<sup>24</sup>

## 8. Values and Environmental Policy

- a. The first substantial steps taken toward a national environmental policy came about during the 1965-1970 period. These were mainly concerned with air and water pollution. While specific limits were generally reserved for the state and local governments, the standards and plans for implementation were subject to the approval of the Environmental Protection Agency (EPA). Under the Water Quality Act of 1965, the states were required to adopt water quality standards, as well as plans for implementation and enforcement. The EPA had the power to set the standards if those proposed by the states were inadequate.<sup>25</sup> By 1995, the standards had been precisely defined on a nationwide basis as a result of research and the observation of the results of various state guidelines. However, by 1995, assessment of the water quality maintained by these guidelines suggested them to be somewhat inadequate. Accordingly, stricter standards were set, and certain bodies of water became subject to programs for renovation.

- b. By 1970, EPA had set air quality standards for the six pollutants shown in the table below.<sup>26</sup>

<u>Pollutant</u>	<u>Level Not to Exceed</u>
Sulfur Dioxide	0.03 ppm annual arithmetic mean 0.14 ppm max. 24 hour concentration
Particulate Matter	75 grams per cubic meter of air annual mean 260 grams per cubic meter of air max. 24 hour concentration
Carbon Monoxide	9 ppm max. 8 hour concentration 35 ppm max. 1 hour concentration
Photochemical Oxidants	0.08 ppm max. 1 hour concentration
Hydrocarbons	0.24 ppm max. 3 hour concentration
Nitrogen Oxides	0.05 ppm annual mean

(Hines 1973, p. 279).

- c. By 1985, levels were established for other pollutants including lead, fluorides, asbestos, and cadmium. By 1995, standards were reduced to:

Sulfur Dioxide	0.02 ppm annual mean 0.11 ppm max. 24 hour concentration
Particulate Matter	60 grams per cubic meter of air annual mean 200 grams per cubic meter of air max. 24 hour concentration
Carbon Monoxide	7 ppm max. 8 hour concentration 30 ppm max. 1 hour concentration
Photochemical Oxidants	0.06 ppm max. 1 hour concentration



Hydrocarbons

0.22 ppm max. 3 hour concentration

Nitrogen Oxides

0.03 ppm annual mean

Car and light truck exhaust levels in 1970 were set at 23 grams carbon monoxide per vehicle mile, and 2.2 grams hydrocarbons per vehicle mile. By 1972 the levels were made specific to each vehicle (instead of allowing an averaging of the exhaust levels) and they were raised to 39 grams carbon monoxide and 2.9 grams hydrocarbons.<sup>27</sup> Due to further refinements in fuels used and to improved methods of pollution control for combustion engines, by 1985 the level for carbon monoxide was lowered without difficulty to 25 grams. By 1995, the levels dropped to 15 grams carbon monoxide and 1.8 grams hydrocarbons.

- d. The Resource Recovery Act of 1970 legislated a shift in emphasis from waste disposal to recycling. Primary responsibility was delegated to the state and local governments.<sup>28</sup> By 1985, recycling and composting processes had been improved. Landfills with composted refuse became common. Reusable containers were being required for many consumer items in all states. By 1995, the use of plastics for disposable items had been severely restricted and was largely replaced by the use of recycleable materials. All states had projects currently in operation for the collection and recycling of materials, and many states provided modest funding for such programs. At the individual level, substantial concern was generated by environmental issues. Membership in citizen lobbies organized around these concerns grew to 1,000,000 by 1985 and 1,400,000 by 1995. Because of citizen demands, of all solid waste in the U.S., 65% was being effectively recycled in 1985, and 80% in 1995. By-products in the form of waste and pollutants converted into salable products grew to 8% in 1985 and 12% in 1995, while the percentage of GNP devoted to saving, protecting, and restoring the environment increased from 5% in 1985 to 7% in 1995.
- e. The U.S. in the 1970's was committed to raising the standard of living of its citizens, and, therefore to the planning, direction, and control of social change. Human values, however, are resistant to social change. Indeed, the existence of "cultural lag" (Ogburn) behind technological innovation proved to be especially troublesome in the mobilization of individuals in movements to protect and repair the environ-

ment. Since value systems seems to originate and/or change only as man attempts to solve the problems of survival, it is only when survival itself becomes the issue that concern over the relationship of man to nature occupies a primary position.

## 9. International Situation

- a. The Cuban missile crisis was something of a watershed in the realm of international relations. Following this confrontation in 1962, U.S.-Soviet relations improved, eventuating in a partial and somewhat uneasy detente by the early 1970's--a detente which, nevertheless, remained intact (and even stabilized to some degree) in the 1980's and 1990's. Evidence of more harmonious relations was seen in a series of arms limitation agreements, expanded trade, and cultural exchanges between the two countries.
- b. One major impetus to U.S.-Soviet detente was a heightened recognition of common interests among Third World nations. In fact, the world situation moved away from East/West confrontation toward a North/South (or "have/have not") polarization. One outcome was that raw materials in general, and energy resources in particular, became more expensive and difficult to obtain. The situation was further complicated by a Third World schism between oil-rich Middle East countries able to draw on vast natural resources in building their economies and the less affluent nations of the Third World.
- c. Although military strength remained one of the primary underpinnings of international power, economic strength assumed greater significance as a power base. By 1985, it could be stated that economic potency had begun to parallel military might as a determinant of the degree of influence in the international arena.
- d. The United States became increasingly involved and interdependent with other nation-states because of simple self-interest as well as humanitarian reasons. Various types of foreign-aid programs provided assistance for developing countries. At the same time, it was necessary to depend more heavily on developing nations as suppliers of raw materials. There was significant progress in coal

gasification and liquefaction technology by 1985, followed by some extension of commercial use of nuclear power provided by breeder reactors by the year 2000, but it was still necessary to rely on conventionally extracted petroleum as the major energy source. It was simply not economically feasible to install the advanced energy production methods on a nation-wide scale before the end of the century. As a result of these factors, the U.S. was able to obtain only about half its petroleum from domestic sources in 1985 and only about 45% in 1995.<sup>29</sup>

#### FOOTNOTES

<sup>1</sup>U.S. Bureau of the Census, Statistical Abstract of the United States: 1973, (94th edition). Washington, D.C., p. 11, Table 9; U.S. Current Population Reports, Series p-25, No. 499.

<sup>2</sup>A. Downs, Urban Problems and Prospects. p. 9.

<sup>3</sup>Statistical Abstract of the United States, op. cit., p. 17, Table 16 and p. 19, Table 19; U.S. Census of Population, 1960 and 1970, Vol. 1, Parts A and B.

<sup>4</sup>Statistical Abstract of the U.S., op. cit., p. 17, Table 16.

<sup>5</sup>Downs, op. cit., p. 25.

<sup>6</sup>Amos Hawley, Urban Society (New York: Ronald, 1971): 156; D. Bell, The Coming of Post-Industrial Society (New York: Basic Books, 1973): 320-321; Kahn and Wiener, "The Next Thirty-Three Years: A Framework for Speculation," in Daniel Bell (ed.) Toward the Year 2000 (Boston: Beacon Press, 1966): 87.

<sup>7</sup>Olaf Helmer, On the Future State of the Union, (Menlo Park, Calif.: Institute for the Future, 1972): 40.

<sup>8</sup>Bell, op. cit., p. 15.

<sup>9</sup>Ibid. pp. 17-18.

<sup>10</sup>Ibid.

<sup>11</sup>Hawley, op. cit., p. 192.

<sup>12</sup>Steinhart and Steinhart, Energy (North Scituate, Mass.: Duxbury Press, 1974): 231-235.

- <sup>13</sup>Commission on Population Growth and the American Future, Population, Resources, and the Environment, Ronald G. Ridker, Editor. Vol. III of Commission research reports. (Washington, D.C.: Government Printing Office, 1972): 23.
- <sup>14</sup>Ibid., p. 108, Table 1.
- <sup>15</sup>Walter G. Dupree, U.S. Energy Use to the Year 2000, (Washington, D.C.: U.S. Department of the Interior, Dec., 1972): 6.
- <sup>16</sup>Bell, op. cit., p. 325.
- <sup>17</sup>Steinhart and Steinhart, op. cit., pp. 55-56.
- <sup>18</sup>Ibid., pp. 221-225.
- <sup>19</sup>Robert W. Prehoda, Designing the Future (Philadelphia: Chilton Book Co., 1967): 162-165.
- <sup>20</sup>William Butz and Paul Jordan, "Population Change and Public Resource Requirements - Education," President's Comm. on Population Growth and the American Future, Vol. II, Economic Aspects of Population Change (Washington, D.C.: Government Printing Office, 1972): 197-215.
- <sup>21</sup>Ibid.
- <sup>22</sup>Ibid.
- <sup>23</sup>Ibid.
- <sup>24</sup>Helmer, op. cit., p. 40.
- <sup>25</sup>Ibid.
- <sup>26</sup>Stanley E. Degler, Federal Pollution Control Programs: Water, Air, and Solid Wastes (Washington, D.C.: Bureau of National Affairs, 1971): 49.
- <sup>27</sup>Lawrence G. Hines, Environmental Issues (New York: Norton, 1973): 279.
- <sup>28</sup>Degler, op. cit., p. 27.
- <sup>29</sup>Ibid. p. 36.

## Resumes of Boundarios

### SCENARIO #1

The general theme characterizing the United States in this portrayal of the future is economic expansion. A general consensus existed in the society supporting economic expansion and industrial growth. Although the society was heavily oriented toward a service economy, "privatism" characterized the economic structure. The supply and consumption of energy were virtually unconstrained.

### SCENARIO #2

The general theme characterizing the United States in this portrayal of the future is represented by increased environmental concern and ecological planning. A general consensus existed in the society supporting a national environmental policy. Further, this solidarity directly affected other social institutions, such as the economy. The consumption and production of energy were significantly constrained in comparison to those levels characterizing the 1960's and 1970's.

### SCENARIO #3

The portrayal of the future United States represented in this scenario is one characterized by increased governmental planning. The major effort at all levels of government in this society was an expansion of programs to produce equality of educational and economic opportunity. As the goals of these efforts became realized, the demand for energy was increased. This effect owes to the positive relationship between socio-economic status and energy consumption.

### SCENARIO #4

Technological domination and advances characterize this portrayal of the future United States. In a sense this scenario represents most optimistic representation of the future society. Technological advances were impacting all the social institutions, especially the economy. The efficient production of goods and services were high. The production of energy was more efficient than in the past, and the demand for energy was virtually congruent with the supply.

## SCENARIO #5

The general theme characterizing this representation of the future United States is large scale economic recession. There existed in the early 1980's an inflationary spiral and a breakdown in the international monetary system. "Privatism" continued to characterize the economic structure although some restrictions were placed on the conduct of business. A number of public works projects, including environmental restoration, were initiated during this period to stimulate the economy. This task was all the more difficult owing to scarcities of energy and other resources, as well as significant international competition for them.

## SCENARIO #6

The general theme characterizing this portrayal of the future United States is international disarray. The economic and political policies discussed in this scenario resulted in the assumption by the United States of an increasingly isolationist stance in the 1980's and 1990's. The United States' Middle East policy was an ambiguous one aimed at placating the Arabs and Israelis while pleasing neither. Accordingly the Arabs again utilized an oil boycott to influence world opinion with the result that the United States placed primary importance on the domestic development of energy. Diverse production strategies were employed by this country in an attempt to meet the demand for energy.

## APPENDIX I.A

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## APPENDIX I.B

FACTORS CONSIDERED FOR USE IN DEVELOPING SCENARIOS  
FOR FUTURE ENERGY DEMAND IN THE U.S.

## I. POPULATION

- A. Growth Rate
  - 1. Fertility - contraception
  - 2. Family size
  - 3. Decline in mortality and increase in life expectancy
- B. Population Size
- C. Composition
- D. Migration

## II. ORGANIZATION - LABOR FORCE

- A. Sectoral Transformation
  - 1. Decrease in importance of labor unions
  - 2. Increase in female participation
- B. Composition and Participation
  - 1. Age
  - 2. Sex
- C. Length of Work Week
  - 1. Decrease in journey to work
  - 2. More labor-intensive production
- D. Shift Work
- E. Public (Non-Profit) Activities
- F. Occupation
  - 1. More professionals
  - 2. More clerical
- G. Under- and Unemployment
- H. Personal Disposable Income
- I. Inflation

## III. URBANIZATION

- A. Density
- B. Peripheral Sprawl
- C. Residential Segregation
  - New transportation systems may be needed to transport Blacks out of ghettos to job, etc.
- D. New Towns
- E. Megalopolis - Regional Concentration of Urbanization
- F. High Speed Interurban Transportation
- G. Percent Population Urban - Metropolitan
- H. Centralization

## IV. ECONOMIC STRUCTURE

- A. Income Distribution
  - Increasing equality?
- B. Land-Property Ownership

- C. Centralization - Large Conglomerates
- D. GNP Per Capita

#### V. GOVERNMENT - POLITY

- A. Centralization
- B. Post-Industrial Society - Joining of Politicians, Scientists, and Technicians
  - 1. Specialization - elitism
    - a. Average citizen will not have sufficient expertise or information
    - b. Decline in citizen participation
  - 2. On the other hand, there may be an increase in citizen participation (e.g., Common Cause, conservation movement)
- C. Internal Political Structure
- D. External Policy
  - 1. Detente
  - 2. One world
  - 3. Increasing recognition of common interest among Third World nations
  - 4. Increase in international trade
    - a. Soviet Union granted "favored nation" status
    - b. World common market

#### VI. MILITARY

- A. Defense Budget (size)
- B. Distribution (among sectors)
- C. Research and Development
- D. Troop Deployment
- E. Military Intervention

#### VII. TRANSPORTATION TECHNOLOGY

- A. High-Speed Interurban Transit
- B. Mass Transit - Increased Acceptability to the Public
- C. Cheap, Efficient Individual Transportation (e.g., electric automobile)
- D. Integrated Traffic Flow Management - This variable demonstrates the interrelationship of parameters-- in this case, centralization of control of metropolitan areas is a factor.
  - 1. Automated ground transportation
  - 2. Electronic sensing devices coordinated via computer to control freeway traffic (already in limited operation in Dallas)
- E. Overall Reduction in Transportation Energy Demand (Through some of the developments already listed plus others)
  - 1. Increased use of mass transit
  - 2. Shift back to greater use of more efficient transportation of goods (in terms of k/cal per Ton-Mile). For example, railroads have an efficiency rating of 170 compared to 900 for trucks and 10,000 for air transport.

3. Advances in structural materials directly related to efficiency
- F. Economical Fuel Cells Employed in Various Forms of Transportation
- G. Advances in Aircraft Technology--Given the importance air transport is likely to assume in this project, perhaps some comment will be useful here.
  1. It is evident that the movement of goods (or people) by air is far and away the least efficient means of transportation available. Only in the case where extremely rapid movement is required does it make sense in an energy-shortage situation.
  2. However, technological innovations may well change this assessment.
  3. A plausible example: The development of materials which would allow the operation of engines at significantly higher temperatures would result in a reduction of fuel consumption by, say, 25%. This along with the utilization of lighter, yet stronger structural materials (such as the type employed in the construction of skyscrapers) could materially increase the payload/carrier-weight ratio. One author estimates that transport of material by air can be reduced to one cent per ton mile, thus making aircraft competitive with ground transportation.
- H. Improved and Increased Transportation by Rail
- I. Increased Ability to Transmit Electrical Power over Long Distances (might require "super-conductivity")
- J. Aircushion Water Transport
- K. Individual, Portable Communication Units (telephones) Which May Further Reduce the Need for Transportation.

#### VIII. OTHER TECHNOLOGY

- A. Education
  1. Distribution (advanced education for everyone?)
  2. Education outside traditional settings (e.g., education in the home via TV, interactive terminals)
  3. Computer-based instruction in or outside traditional settings
  4. Public expenditures on education, especially for the educationally deprived
- B. Medical
  1. Breakthroughs in prevention and early detection of diseases (especially in regard to cancer and cardiovascular diseases)
  2. Federally sponsored health insurance for all
  3. Socialized medicine
  4. Cloning--Replacement of ovum with somatic cell leading to the development in a host mother of an identical twin of the supplier of the soma-

tic cell

C. Electronic-Computer Revolution

1. Certain activities which now require leaving home (working, shopping, voting, banking, schooling) might be carried out at place of residence via electronic devices, thus substantially reducing miles traveled per individual. (People will still go somewhere, particularly if technological advance leads to a shorter work week and more leisure time, but an individual or family might go to one place (or a few places) instead of many.)
2. "Electronic books"--i.e., augmentation of information storage and retrieval capabilities and widespread availability on an individual basis.
3. Societal impact of electronic revolution and emergence of an "information society" a la Daniel Bell. What would happen, for instance, if the U.S. became a world repository for technical information with such information its chief export.
  - a. Is there a possibility of an information overload?
  - b. What kinds of coordination and control problems will emerge?

IX. VALUES - LIFE STYLE

- A. Old (materialistic success, work-ethnic) vs. New (self-actualization, non-competitive ethnic)
- B. "Privatism" vs. Public Interest
- C. Rapid Growth vs. Slow (or no) Growth

X. ENERGY ALTERNATIVES

- A. Expansion of Controlled Fission  
Will it make a difference and should we consider whether different methods of nuclear reactors are used? For example, whether burners or breeder reactors (water or gas cooled) are employed. In some types, thermal pollution is more of a problem. Breeder reactors are net producers of fuel while "burners" are net consumers.
- B. Controlled Fusion
- C. Solar Energy
- D. Wind
- E. Geothermal

XI. ENVIRONMENT

- A. Climate Modification
- B. Man-Made Physical Environment (e.g., much larger apartment buildings or self-contained cities within a single structure)
- C. Whole Environmentalist Movement

XII. MISCELLANEOUS

## APPENDIX I.C

MOST IMPORTANT FACTORS  
RELATED TO ENERGY SUPPLY AND DEMAND

1. Population size
2. Peripheral sprawl
3. Metropolitan percent
4. Urban percent
5. Migration
6. Journey to work
7. New Towns
8. Sectoral transformation
9. GNP growth
10. GNP billions
11. 1000 Btu's per \$1 GNP
12. Unemployed
13. Services
14. Work week
15. Labor intensive production
16. Family income under \$3000
17. Median income, White & Non-White
18. % income, top quintile
19. % income, bottom quintile
20. Inflation
21. Government centralization
22. Level of regional metropolitan authorities, 1971=100
23. Centralization of large conglomerates
24. Federal government investment in mass transit
25. % white collar
26. Communication substitution for transportation
27. Societal improvement of communication & information handling revolution
28. % of activities formerly done in home
29. % mass transit intracity miles
30. Interurban & transit system
31. % savings by more efficient transportation use
32. Transportation mode shift %
33. Air transportation
34. % total GNP devoted to saving environment
35. % freight hauled by rail
36. % urban passenger miles via mass transit
37. % waste recycled
38. % salable products from recycled waste
39. % petroleum from domestic sources

## APPENDIX I.D

## BACKGROUND INFORMATION, DATA, AND GLOSSARY

I. POPULATION

- a. The resident population of the United States was estimated at 209.0 million in December, 1972. Earlier numbers, according to official Bureau of the Census statistics, are the following: 1970: 203.2 million; 1960: 179.3 million; 1950: 151.3 million; 1940: 131.7 million (U.S. Bureau of the Census, 1973a, p. 37).
- b. The total fertility rate is the number of births that 1,000 women would have in their lifetime if, at each year of age, they experienced the birth rates occurring in the specified year. A total fertility rate of 2,110 represents "replacement level" fertility for the total population under current mortality conditions. Total fertility rates for the United States for selected years are as follows:  
1973: 1,990 (estimate); 1972: 2,040 (estimate); 1971: 2,280;  
1970: 2,470; 1965: 2,930; 1960: 3,650; 1957: 3,770 (peak of baby boom); 1955: 3,580; 1950: 3,090; 1945: 2,490. (See U.S. Bureau of the Census, 1973a, p. 61, and Teitelbaum, 1973, p. 70.)  
NOTE: Highs and lows in total fertility rate are 9,991 among the Hutterites in about 1948, and 1,850 in Finland, 1969. (See Eaton and Mayer, 1953, and Teitelbaum, 1973.)
- c. Stationarity (stationary population) may be defined as the absence of population growth. The numbers of persons dying per year are replaced with the same numbers of persons through birth. Present estimates have the United States reaching stationarity about 2020. Although we are presently below replacement level fertility, we will continue growing beyond the year 2000 because of the larger

cohorts of adults, responses to the "baby boom" which occurred after World War II through 1957 (Frejka, 1973).

## II. URBANIZATION

- a. Standard Metropolitan Statistical Area (SMSA) is defined generally as a county or group of counties containing at least one city (or twin cities) having a population of 50,000 or more plus adjacent counties which are metropolitan in character and are economically and socially integrated with the central city. (See U.S. Bureau of the Census, 1970, p. 83 for more detail.)
- b. Percentage metropolitan refers to the percent of the total U.S. population living in SMSAs. The percentage in 1950 was 63%, in 1960, 67%, in 1970, 69%. (See U.S. Bureau of the Census, 1973a, p. 42.)
- c. Percentage urban generally refers to the percent of the total population living in places of 2,500 or larger in population. (See U.S. Bureau of the Census, 1970, p. 82 for more detail.) The percentage in 1960 was 70%, in 1970, 74%. (See U.S. Bureau of the Ceneus, 1973a, p. 42.)
- d. Population mobility refers to change of residence. There are usually two components to the phenomenon: migration and short distance or within county mobility. The former refers to a change in residence involving a move to a new county; the latter refers to a change of residence within the same county. Between 1965-66, 7% of the U.S. population changed residences between counties, and 13 percent changed residences within the same county, for a total of 20%.



Between 1970-71, 6% of the U.S. population changed residences between counties, and 11 percent changed residences within the same county, for a total of 17%. (See U.S. Bureau of the Census, 1973a, p. 49.)

- e. Peripheral sprawl refers to the percentage of the total U.S. population residing outside the central or core city. In 1950 this percentage was 27%, in 1960, 34%, and in 1970, 37%. (See U.S. Bureau of the Census, 1973a, p. 42.)
- f. Level of Regional Metropolitan Authority refers to the extent to which regional and metropolitan councils and authorities (e.g., the Association of Bay Area Governments, the Port of New York Authority) have been brought into existence. In the projected index numbers, it was assumed that the index number for 1971 was 100. (See Helmer, 1972, p. 40.)

### III. LABOR FORCE

- a. Sectors. When conceptualizing the industrial base of the United States, or any other country for that matter, it is useful to think in terms of the three industry sectors: agricultural, industrial, and services. As Fuchs (1968) has observed, "during the period following World War II this country became the world's first 'service economy' -- that is, the first nation in which more than half of the employed population is not involved in the production of food, clothing, houses, automobiles, or other tangible goods" (p. 1), but instead in services. The service sector is defined to include wholesale and retail trade; finance, insurance, and real estate; general government; and professional, personal, business

and repair services. The industry sector is defined to include mining, contract construction, manufacturing, transportation, communications, and public utilities. (Fuchs, 1968, p. 2.) The service sector's share of total employment was 40% in 1929, 55% in 1967, and 60% in 1970. (Fuchs, 1968, p. 2; Bell, 1973, p. 13.)

- b. Journey to Work. The separation of home from place of work has become more prevalent during the nineteenth century. By 1920 the average distance was 1.5 miles. Work-trip distance lengthened rapidly, and by 1960 such distances averaged 4.7 miles. Today (1970) the distances for white workers average 3 miles for laborers, 7 miles for professionals. (Hawley, 1971, p. 191-192; Poston, 1972.)
- c. Work week (hours). The average number of hours worked per week has been declining in recent years. The average work week in 1971 among fully employed persons was about 38 hours. (Helmer, 1972, p. 34.)
- d. Percentage unemployed. This statistic is defined as the percentage of the labor force who were neither "at work" nor "with a job but not at work" during the reference week but were looking for work during the past 60 days. (U.S. Bureau of the Census, 1970, p. 103.) The percentages for the United States for selected years are the following: 1929: 3.2%; 1930: 8.7%; 1933: 24.9%; 1935: 20.1%; 1940: 14.6%; 1960: 5.5%; 1965: 4.5%; 1970: 4.9%; 1971: 5.9%; 1972: 5.6%. (Robertson, 1973, p. 682; U.S. Bureau of the Census, 1973a, p. 132.)

#### IV. THE ECONOMY

- a. Gross national product may be defined as including private economy gross product plus government product. GNP figures in 1958 dollars, in billions, for selected years are the following: 1950: 355,288; 1955: 437,963; 1960: 487,682; 1965: 617,799; 1968: 707,608. (U.S. Commission on Population Growth and the American Future, 1972, vol. II, p. 372.)
- b. Growth rate of Gross National Product. Average annual growth rate of GNP between the years 1950-1968 (computed on the basis of 1958 dollars) was 3.9%. (U.S. Commission on Population Growth and the American Future, 1972, vol. II, p. 372.)
- c. Energy consumption per \$1 of GNP. An important energy consumption statistic is the ratio of Btu's of energy consumed in the United States for each \$1 (in constant prices) of Gross National Product. As the following data will illustrate, there has been a long term decline in this ratio since 1920: 1920: 141.3; 1930: 121.5; 1940: 105.2; 1950: 96.1; 1960: 92.2; 1970: 95.0. (U.S. Commission on Population Growth and the American Future, 1972, vol. III, p. 108.)

#### V. SOCIAL EQUALITY

- a. Percentage of families with incomes under \$3,000. This statistic is computed in constant (1972) dollars. The percentages for selected years are the following: 1950: 21%; 1955: 17%; 1960: 14%; 1965: 11%; 1970: 8%; 1972: 7%.

- b. Median income. This statistic is also computed in constant (1972) dollars. For whites and nonwhites for selected years, the medians are as follows: 1950: whites, \$5,986, nonwhites, \$3,248; 1960: whites, \$8,267, nonwhites, \$4,564; 1970: whites \$11,030, nonwhites, \$7,018; 1972: whites, \$11,549, nonwhites, \$7,106. (U.S. Bureau of the Census, 1973a, p. 200.)
- c. Percent white collar. This percentage is defined to comprise workers in the professional, managerial, sales and clerical occupations. For white workers and for nonwhite workers, for selected years, the percentages are as follows: 1960: whites, 46.6%, nonwhites, 16.1%; 1970: whites, 50.8%, nonwhites, 27.9%; 1972: whites, 50.0%, nonwhites, 29.8%. (U.S. Bureau of the Census, 1973b, p. 234.)

## VI. TRANSPORTATION

- a. Government investment in mass transportation. Here the concern is with the cumulative investment (in billions of constant dollars) by the federal government in mass transportation (other than highways). This number was estimated to be 1 billion in 1971. (Helmer, 1972, p. 37.)
- b. Communication substitutes for transportation. Certain activities, which now require leaving one's home (i.e., working, shopping, banking, etc.) may in the future be replaceable by equivalent activities carried out through electronic activities at home. For 1971, the percentage of this time (activities carried on at home electronically) is estimated at 1%. (Helmer, 1972, p. 39.)

## VII. EDUCATION

- a. Percentage of GNP Spent on Education. Total educational expenditures as a percent of GNP was 5.4% in 1960, and 7.5% in 1970. (Butz and Jordan, 1972, p. 197.)

## VIII. VALUES AND ENVIRONMENTAL POLICY

- a. Percentage salable products from recycled material. As a consequence of the growth of concern over environmental spillovers from economic activities, a growing market may arise for activities whose productivity will derive from their contributing either to reducing waste or to recycling it for subsequent sale in different forms. Thermal pollution, water and air pollutants, and household and industrial waste will thus either be diminished or turned to economically salable products. The estimate of the percentage of the volume of waste products and pollutants that this industry converted into salable products in 1971 was 1.5%. (Helmer, 1972, p. 36.)
- b. Percentage of the total GNP devoted to saving, protecting, and restoring the environment was estimated to be 1% in 1971. (Helmer, 1972, p. 35.)

APPENDIX I.E

Relevant Energy Factors (1985)

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
1. POPULATION							
Fertility Rate	1.9	1.9	1.8	1.9	1.9	1.8	1.9
Size (millions)	231	231	228	231	231	228	231
2. URBANIZATION							
Metropolitan**	70	74	69	70	70	70	70
Urban**	77	79	75	77	78	77	77
Migration							
Total**	20	22	20	20	21	18	20
Short distance	13	12	13	13	14	11	13
Peripheral Sprawl***	40	42	35	39	40	39	40
New Towns	not likely	likely but inadequate	likely but inadequate	likely but inadequate	likely but inadequate	very limited growth	likely but inadequate
Level of Regnl. Metropolitan Authorities 1971=100	175	175	200	200	175	175	175
3. LABOR FORCE							
Labor Intensive Production	same	same	same	same	less	more	more
Services %	70	72	70	72-73	72	70	70
Journey to Work for Whites(mi.)	3-laborers 7-laborers	3-laborers 7-laborers	3-laborers 7-laborers	3-laborers 7-laborers	4-laborers 7-laborers	3-laborers 7-laborers	3-laborers 7-laborers
Work Week (hrs)	35	35	35	35	33	40	38

\*\* U.S. Population

\*\*\* SMSA Population in Fringe Areas

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
4. THE ECONOMY							
GNP in \$Billions	1,332	1,508	1,251	1,251	1,500	720	1,220
% GNP Growth	4.0	5.1	3.5	3.5	5.0	no change	3.3
1000 Btu's Per \$1 GNP	86	79	90	86	77	93	87
5. SOCIAL EQUALITY							
Family Income <\$3000	4%	4%	7%	3%	4%	7%	4%
Median Income							
White	12,500	14,000	12,500	13,000	14,000	10,000	12,500
Non-White	9,500	10,000	9,500	11,000	10,000	6,300	9,500
% Income Top Quintile	42	43	42	42	42	45	42
% Income Bottom Quintile	7	6	7	9	7	5	7
% White Collar							
White	55†	60	60	60	60	†	55†
Non-White	38	40	42	42	42	32	38†
6. TRANSPORTATION							
% Freight Hauled by Rail	46	†	50	46	46	50	46
% Urban Passenger Mass Transit Mi.	12	15	26	25	12	30	12
Fed. Govt. Invest. in Mass Transit (in billions)	15	25	25	25	20	8	10†
% Transport Mode Shift due to Energy Conserv.	4	4	6	6	9	12	4
% Savings due to More Efficient Use	10	10	15	15	18	15†	10
Communication Sub. % Transp. Energy	7	8	7	7	10	3	7
% Average Air Payload/CarrierWt	25	25	25	25	40	15	25

†Missing from Scenario

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
7. EDUCATION % GNP Spent	8.1	8.1	8.1	8.1	8.1	4.0†	8.1
8. VALUES & ENVIRONMENTAL POLICY							
% Wastes (solid) Recycled	50	50	75	60	65	65	60
% Salable Prods from Recycled Material	6	8	15	8	8	6	8
% Total GNP Devoted to Saving Environ.	5	3	10	5	5	2	5
9. INTERNATIONAL SITUATION							
% Petro from Domestic Source	50	50	45	55	55	50	63

†Missing from Scenario



Relevant Energy Factors (1995)

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
1. POPULATION							
Fertility Rate	1.8	1.9	1.6	1.8	1.8	1.6	1.8
Size (millions)	246	251	241	246	246	241	246
2. URBANIZATION							
Metropolitan**	70	78	70	70	70	71	70
Urban**	80	82	76	80	81	80	80
Migration							
Total**	20	22	20	20	21	18	20
Short distance	13	12	13	13	14	11	13
Peripheral Sprawl***	30	45	36	39	43	41	43
New Towns	not likely	likely but inadequate	likely but inadequate	likely but inadequate	likely but inadequate	very limited growth	likely but inadequate
Level of Regnl. Metropolitan Authorities 1971=100	275	275	300	300	275	275	275
3. LABOR FORCE							
Labor Intensive Production	same	same	same	same	less	more	more
Services %	70	75	70	72-73	75	70	70
Journey to Work for Whites (mi)	3-laborers 7-profesnl	3-laborers 7-profesnl	3-laborers 7-profesnl	3-laborers 7-profesnl	4-laborers 7-profesnl	3-laborers 7-profesnl	3-laborers 7-profesnl
Work Week (hrs)	32	32	32	32	31	40	35
Unemployed %	5.2	3	7	6	8	8	6.5

\*\* U.S. Population

\*\*\* SMSA Population in Fringe Areas

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
4. THE ECONOMY							
GNP in \$Billions	2,088	2,479	1,799	1,816	2,480	1,170	1,720
% GNP Growth	4.6	5.1	3.7	3.8	5.1	5.0	3.5
1000 Btu's Per \$1 GNP	80	65	82	80	63	88	81
5. SOCIAL EQUALITY							
Family Income <\$3000	3%	3%	3%	2%	3%	7%	3%
Median Income							
White	15,000	17,500	14,000	15,000	17,500	12,500	15,000
Non-White	12,500	12,500	12,500	13,000	12,500	8,500	12,500
% Income Top Quintile	42	43	42	40	42	45	42
% Income Bottom Quintile	10	88	10	13	10	5	10
% White Collar							
White	60†	65	62	65	65	†	60†
Non-White	45	50	52	52	52	38	45†
6. TRANSPORTATION							
% Freight Hauled by Rail	50	45	55	50	46	55	50
% Urban Passenger Mass Transit Mi.	17	20	31	30	17	35	17
Fed. Govt. Invest. in Mass Transit (in billions)	25	40	40	40	40	18	20†
% Transport Mode Shift due to Energy Conserv.	5	5	10	10	14	15	5
% Savings due to More Efficient Use	15	15	20	20	21	20†	15
Communication Sub.							
% Transp. Energy	14	15	14	14	20	8	14
% Average Air Payload/CarrierWt	35	35	35	35	50	20	35

†Missing from Scenario

	Most Likely	Economic Expansion	Environmental Concern	Social Equality	Technology Dominated	Economic Upheaval	International Disarray
7. EDUCATION % GNP Spent	8.1	8.1	8.1	8.1	8.1	4.0†	8.1
8. VALUES & ENVIRONMENTAL POLICY % Wastes (solid) Recycled	60	60	90	70	80	65	70
% Salable Prods. from Recycled Material	10	12	22	12	12	10	12
% Total GNP Devoted to Saving Environ.	6	5	15	7	7	5	7
9. INTERNATIONAL SITUATION % Petro from Domestic Source	40	40	30	65	65	50	80

†Missing from Scenario

PART II

PRE-WORKSHOP SCENARIO TEST

## A. GENERAL BACKGROUND

### Purpose

The purpose of this phase of the project was to "field test" the scenarios developed for the workshop by The University of Texas researchers and the potential action statements and energy supply estimates prepared by the TRW, Inc. In addition to providing a very valuable critique of the clarity, comprehensiveness, and consistency of the six draft scenarios and the supporting materials, this "trial run" served as an excellent test of the potential effectiveness of the Alternate Scenario Planning technique at the workshop, since the mix of disciplines involved roughly paralleled that of the workshop participants.

### Conduct of the Tests

A total of eighteen graduate students pursuing doctorate and master's degrees were selected as participants. The disciplines represented included economics, engineering, geography, government, sociology, psychology, geology, business administration, and community and regional planning. Six work groups of three students each were established. Each group was given a different scenario to review critically for inconsistencies and obvious errors and each was asked to evaluate the compatibility of scenarios with potential action plans and supportive data. The groups were required to prepare an oral report to be given at the end of the test period.

The entire test period, which included the introduction, work session, oral report, and discussion lasted five hours. The actual work session for the teams lasted three hours. A member of the University team was assigned to each to assist in scenario interpretation to act as a catalyst to keep each team from becoming overly involved in details and to list problem areas for future correction. The University team members were graduate research assistants who had been involved in the research, planning, and development of the scenarios. The use of these people proved to be an important asset to this test exercise.

## B. TEST RESULTS

The University team member working with each group prepared an evaluation of the work session independent of the report prepared and presented by that group. In addition to the oral report each group returned a copy of the scenario with annotated comments and corrections. These are attached in Appendix H.

Listed below are brief resumes of group reports for each scenario and an outline of student comments.

### Scenario I: Economic Expansion

#### Report

If we wish to maintain an expanding economy and to increase or continue the trends toward more efficient energy use, we must identify and confront the following problems (in order of priority):

1. Need to decrease dependence upon foreign imports of energy-producing fuels;
2. Need to decrease dependence upon petroleum, especially given 1. above and the lack of progress in the area of pollution control;
3. Need to increase efficiency of private automobiles since efforts have failed to significantly reduce dependence on auto-transport; and
4. Need to increase rail capacity.

Given these goals, the most important solutions are in the following areas: the development of new primary energy sources; the production of domestic energy from conventional sources; an increase in the efficiency of automobiles and airplanes (or the encouragement of mass transit in such a vast scale of urban sprawl, which would entail a basic value change and de-emphasis of importance and accept-

ance of private automobiles as primary means of transportation); and redistribution of energy.

A national oil stockpile would add to economic stability. This economic stability would be necessary to insure solutions in privately subsidized industries such as oil shale, coal liquefaction, nuclear and other energy-providing production.

Good international relations with energy-rich countries will be essential until internal national energy sources are developed and expanded.

Existing policies involving secondary and tertiary recovery and offshore exploration should be continued and expanded.

It is important to continue the U.S. position in the international community as a dominant food-producer and technology-leader and exporter in order to purchase other minerals and raw materials which are required in an industrial economy but which are minimal or too costly to produce in the U.S. and to assure some leverage in an increasingly interdependent international relationship.

#### Comments

The work group on economic expansion and portable energy assessment had difficulty getting off the ground. It may not have been the scenario itself, but rather the lack of ability on the part of the students to get oriented to the task. In retrospect, a conflict may have existed between value orientations and the task at hand; i.e., the students were fairly environmentally minded and resented the probable, or assumed future, as one of economic growth with disregard of many of today's social problems. Once they were able to under-



stand that they were to play the role of a planner given that this was the future, the work session was greatly facilitated.

The primary criticisms made by the group were that time was too short and that they had no clear picture of energy demand for this objective future.

## Scenario II: Environmental Concern

### Report

The general theme represented by the scenario is one of increased environmental concern and ecological planning. A general consensus existed in the society supporting a national environmental policy which significantly affected and constrained consumption and production of energy.

The students recommended various policies and programs which they felt deserved attention such as the following:

1. improve efficiency in general;
2. develop processes for synthesizing methyl fuel from coal;
3. substitute coal-derived synthetic fuels for oil;
4. increase domestic oil and natural gas production;
5. import energy with directly related foreign policy incentives to reduce impact of cartels (e.g. OPEC and weapons); and,
6. national petroleum stockpile for imported and domestic energy.

### Comments

Confusion evolved around the data supplied (e.g., the base for constant dollars). Again a glossary was cited as a necessity. An inconsistency was identified regarding the percentage of whites employed in white collar occupations. Also a possible inconsistency regarding rail and air markets was noted. In fact, the section on

transportation was too vague to be of significance in the evaluation of the scenario. In general, the team felt that the scenario was too conservative and therefore not very realistic.

The team cited several potential actions which they felt were of importance in this scenario of increased environmental concern. Initially, the lack of hard environmental data and particularly "trade off" or "impact" data were lacking, thereby restraining the effectiveness of decision-making. The strong bias against petroleum and the automobile was too apparent in the supportive data and constrained the initiative of the team. The team felt more energy alternatives should have been identified such as solar, wind, geothermal, and tidal energy sources. Overall, a greater emphasis was needed on the prospects of rail and other modes of mass transit.

### Scenario III: Social Equality Report

The increased planning activity by governmental agencies is the main base for this scenario. The major effort at all levels of government was an expansion of programs to produce equality of education and economic opportunity. Consequently, the demand for energy increased due to the direct relationship between energy consumption and socio-economic status.

This scenario of involved governmental planning assumed that lowering the energy demand curve by employing government action would increase efficiency. Such recommended actions included the building of stationary power plants with dependence on fossil fuels until breeder reactors become available. It was concluded that

portable power sources will continue to be oil derivatives, but the ultimate goal would be to use hydrogen for fuel, with coal as the primary source. Also, electrical energy produced by hydrolysis should be used.

### Comments

The students felt a need for more information, particularly data input which they were not supplied. The scenario represented a quantitative but not a qualitative change; however, they did not elaborate. They expressed a need to know our own resources for international trade. This, among other areas, did not provide a basis for governmental decision-making, i.e., values, power groups, etc. An important recommendation cited by the team was the need for a scenario glossary which would provide a common reference for all teams and team members.

As stated by other teams, the need for more information on implementation time, costs, trade-offs, and statements of the economic impact of the actions was noted.

### Scenario IV: Technology Dominated Report

Technological domination and advances are the principal themes of this scenario. It is the most optimistic representation of our present society and characterized by high levels of production and efficient energy productivity matched with sufficient supply.

The team testing this scenario identified many potential actions. Synthetic fuel was set out as an item of first priority with several approaches to achieve this objective. The first step would be to develop processes for the synthesis of coal or fossil

fuels to be introduced into the transportation sector to relieve the demand for gasoline. Also cited was the need to develop a process to convert waste materials into useable fuels for the transportation sector. A counterpart of these objectives is the need to redistribute the energy such as developing an electric or battery powered automobile.

Another recommended action was to improve the efficiency of energy utilization such as the efficiency of the internal combustion engine used in the automobile. It was suggested that the demand for energy in the transportation sector could be altered by more efficient use of private and public transportation. Another consideration was the desire to increase the load factors in commercial aviation.

It was recommended that more rigid building codes be instituted to require full insulation of all residential/commercial buildings. It was further urged that energy considerations be given full priority in the planning, design, and construction of all public and private facilities.

#### Comments

The team singled out specific details for comment. In the area of population projections it was felt that projected life expectancy was too conservative. Such urbanization trends as the continuance of peripheral sprawl were questioned. An inconsistency was noted in the continuance of racial segregation in light of programs of increased social equality. In the economy description, the inflation analysis was unclear and a glossary of terms was suggested, (e.g., prime mover). In employment figures, women were not included in the labor force.

Concerning transportation, the team members disagreed with the description of air transport as an inefficient means of transport. Also questioned was the degree of importance of electronics or communication as a substitute for transportation.

In all, the team felt uneasy with the scenario and felt the need for additional clarification or advanced preparation prior to testing the scenario.

#### Scenario V: Economic Upheaval

##### Report

The major problems pinpointed in the "pessimistic" scenario are the depression and the transportation issue. Transportation was the greatest single energy-user and can be expected to make increasing demands on the economy in the future. Since transportation is primarily petroleum-based, the expected decrease in domestic oil production and increased reliance on imported oil will result in greatly increased energy costs. Due to the financial restriction of a crisis-ridden economy and the urgency of energy needs, the possibility of increasing the oil supply through increased importation or extensive domestic research and development is not feasible. Thus, the following policy suggestions emphasize reducing the U.S. demand for petroleum.

Potential actions are divided into immediate and long range actions. The primary immediate action proposed is the creation of a national petroleum stockpile, necessary to prevent another crisis in the near future. The costs involved are not prohibitive, the plan can be implemented in a short length of time, and it may result in substantial savings in the near future.

Further immediate action involved maximization of the recovery of oil from proven domestic reserves using improved secondary and tertiary methods. This action is feasible within a short time period, and costs are competitive with present import methods.

Long range actions focus upon redirection of the fuel basis and modes of transportation.

Transportation can be subdivided into categories: intercity and urban. Both means are largely based on petroleum fuels, which are in short supply. Therefore, we must either reduce the use of transportation or use fuels other than petroleum if we are to avoid a future showdown between petroleum demand and the enormous costs entailed.

Urban mass transit must be increased through expanded use of buses and rail. Buses use petroleum, but rail transit is electrically powered, originating from coal or nuclear energy. As most urban travel is work-oriented, the long range implication is for a change in land use patterns toward less suburbanization.

The creation of a few highly used rail lines in our transportation corridor will become a very attractive candidate for human and freight transportation.

It is imperative that public transportation use be expanded, deriving its energy sources as much as possible from resources other than petroleum.

#### Comments

The scenario was not pessimistic enough! Trouble arose due to incorporation in the scenario of policies and results for a depression which was waning. This appeared to suggest in advance

which potential actions to choose.

There was a shortage of time to perform adequately the required review. It was suggested that each person receive the scenario at least a day in advance of the workshop or even the test.

There was uncertainty in the scenario over the magnitude of the energy demands because the scenario described a state of flux rather than a stable condition.

The scenario failed to discuss rising land and housing costs and their effect on energy requirements.

#### Scenario VI: International Disarray

##### Report

This scenario depicts the U.S. moving toward a policy of isolationism, particularly in the areas of economy and politics. Foreign policy of the U.S. creates distrust in the Middle East and the threat of an oil boycott places increased importance on domestic development of energy. Diverse production strategies were employed by this country in an attempt to meet the demand for energy.

In the area of potential actions, the need for substitute synthetic fuels derived from coal for use in the utilities, industrial, and commercial sectors was stressed. The team members suggested that this oil savings could be used in the transportation sector. This would be facilitated through coal liquefaction, coal gasification, and nuclear power plants. In addition, increased domestic oil production was supported through maximizing the recovery of oil, and encouragement of the exploration of the outer continental shelf. The derivation of methyl fuel from coal was suggested by the team as a potential action which could aid the energy supply side in the transportation sector.

Other potential actions included efficiency measures which could be taken to aid the short term energy picture. Most of these recommendations were aimed at the transportation sector and included the improvement of automobile efficiency, continued maximum legal speed of 55 mph, more effective use of public and private transportation, and increase in the commercial airline load factor.

In addition, the team felt very strongly that more stringent building codes needed to be instituted to require proper insulation of all residential and commercial buildings.

#### Comments

In the international scene described in the scenario, it was not clear how Sino-Soviet relations would affect U.S.-Soviet detente. Clarification of this point was suggested. The statistics concerning the urbanization narrative were unclear, and again clarification or expansion of that section was recommended. Other similar comments were made concerning the tertiary, service, white-collar labor force, and the railroad percentages cited for the transportation sector.



### C. CONSLUSIONS

The results of the scenario test were transcribed into revisions of the scenarios where deemed appropriate by the research staff. The inconsistencies which were identified, typographical errors, and those areas of each scenario where clarification was recommended were corrected.

In the students' scenario test one universal recommendation was that more time was required to work adequately on the scenarios; therefore, the scenarios should be made available to each participant at least a day in advance to insure adequate preparation time. Also, the supporting data such as the potential actions, appendices, energy demand curves, and conversion figures to enable direct comparison or "common basis" figures, were needed to adequately evaluate the scenarios. A glossary was one of the most widely recognized requirements since it would provide the students and conference participants with a common "baseline."

In the actual mechanics of the student test, some teams worked more efficiently and were more organized than others. Some approaches were more methodological and the options available to them were more effectively evaluated. However, some scenarios were more readily understandable and their options more clearly defined, such as the one provided to the economic crisis team. Obviously some of the criticism and recommendations in the previous section of this report reflect a lack of comprehension by the teams of the impact of the scenario; however, some criticisms were well founded and the scenarios

appropriately revised.

Overall, the student test was most beneficial to the researchers since we were able to gain insight into how this brainstorming conference would develop. However, for major revisions in scenario and potential actions, the test was of limited application since alternative scenarios could not be completed under the time constraints. It is recommended that future projects such as this require a pre-test and allow sufficient time to incorporate fully those conclusions derived from the pre-test.

In all cases the students were enthusiastic about the role and importance of the scenario approach to providing the setting for assessing potential action and alternative approaches to achieving the objective of the workshop.

The recommendations derived from the pre-test and applicable to the conference workshop were incorporated wherever possible. Some of the recommendations which clearly need emphasis are presented for future consideration.

- (1) It is important that the conference participants read the scenarios, potential actions, glossary, and supportive data prior to the first session.
- (2) Some mechanism is needed to destroy social and intellectual barriers erected in conferences of this type. Small working groups with a designated leader may facilitate informality, social and open contact. Also a teacher can insure that the team does not get too bogged down or get tangential to the main issues.
- (3) Each participant should be clearly informed and cognizant of the goals and objectives of the conference and each session, the role he is to play, and the prescribed approach to achieving it.

- (4) The scenarios and potential actions can greatly facilitate the nucleating of these teams and provide a framework from which strategies can be developed and pursued. Participants must be aware that the scenarios provide the common ground from which changes, additions, deletions and any other appropriate action are encouraged if not required if the conference workshop is to achieve its goal.

PART III

OBSERVATIONS ON WORKSHOP PREPARATION, CONDUCT, AND RESULTS

## A. INVESTIGATORS' REMARKS

### General Comments

Although the Portable Energy Technology Assessment Workshop appears to have been effective in underscoring the complexity of the nation's energy problem and improving communication between different sectors of our society involved in solving energy problems, it is the opinion of The University of Texas team that the full potential of the Alternate Scenario Planning technique was not realized at the conference. Although this result may have been due, in part, to shortcomings in the scenarios, the major contributing factors were the facts that the concept of Alternate Scenario Planning was not adequately explained to the participants, that the participants were not familiar with the individual scenarios, and that the importance of first phase conclusions to second phase considerations was not properly highlighted.

One basic purpose of ASP is to force flexibility in planning efforts. The techniques involved in this type of planning are often rather different from those commonly employed, and the strict mental discipline which is required is found to be uncomfortably restrictive by many planners until they understand the overall methodology.

Careful explanation of the purpose, concepts, and procedures involved are vital to prevent confusion, diversion, and antagonism. For this workshop, neither the advanced written material nor the initial briefing of the participants explained what the scenarios represented, how they had been developed, nor how they were to be used. As a consequence

of this inadequate explanation, a great deal of misunderstanding, lack of acceptance, and hostility concerning the scenarios developed. The obvious discontent on the part of some participants is evidenced in the critique sheets and in the diversionary discussion noted in some of the group sessions.

In general, the attendees failed to appreciate the fact that a given scenario described a feasible future, but not necessarily the most probable one. This failure often resulted in groups arguing about the probabilities of events listed in the scenarios actually occurring and, at times, making indiscriminate alterations of scenarios to make them more probable. One participant threatened to leave the conference the first day because he felt that the demand figures given in his scenario were impossibly large. (He later concluded that the listed demand was unlikely, but possible.) In one group a large amount of time was devoted to discussing the accuracy and importance of government production figures. Since such figures were used in the scenarios only to indicate relative growth rates, the exactness of the data would not seem to be particularly germane to the planning issues involved. The assertion was made in one group that an unemployment rate greater than 8% should not be considered, since it would necessarily lead to a revolution. Although this assertion would seem to be subject to debate (the unemployment rate in the 1930's depression was approximately 25%), the statement was accepted and the scenario modified

accordingly.

Although ~~incidences~~ of the type listed above were not fatal to the planning process, they did result in generally unprofitable diversion of effort and probably could have been prevented if the ASP methodology had been explained at the beginning of the conference and if the chairmen and facilitators had been specifically briefed on potential problems and effective methods for dealing with them. In the group in which the chairman seemed to appreciate fully the ASP concept, i.e., the environmental group, the scenario approach seemed to be generally accepted, and the scenario served most effectively to aid in the discussion and planning efforts.

Discussions with both participants and staff indicated that very few participants had read the scenario carefully prior to the workshop and that only a slightly larger number ever became really familiar with them. In many cases participants' objections to parts of the scenarios were due to misconceptions caused by hasty scanning of the material provided. Often these objections were satisfied by a more careful reading. Given the work loads of most of the participants, their failure to peruse the scenario material prior to arrival is not surprising. However, since an understanding of the constraints imposed by the scenarios is essential to a worthwhile ASP exercise, an effective means of familiarizing them with the contents of the scenario is imperative.

One of the key steps in an ASP effort is the comparison of the plans developed as the different futures are considered. This comparison is facilitated by the use of a

structured format for presenting, at least, an outline of proposed actions. Although general discussion outlines were included in the conference notebooks, these outlines were generally not followed in either oral or written group reports. Although this made detailed comparison difficult, a number of very important common conclusions were noted in the group reports. For example, every group indicated that increased energy dialogue was essential to the nation's future and that positive steps should be taken to reduce oil imports. Every group felt that environmental considerations should not be ignored in dealing with energy problems and that federal and private support of new energy source research and development should be increased. Finally, every group (with a few individual dissenters) agreed that increased use of the strip mining of coal and nuclear power would be necessary if the nation's energy requirements were to be met. However, all felt that strict regulations and careful safeguards were necessary in both areas. Given the diversity of the six groups and the differences in the scenarios, such common agreement on these very basic points was extremely significant. An explicit reference to this agreement would have served as an excellent starting point for the second phase of the workshop.

It is felt that the disadvantage of not carefully explaining the ASP technique early in the workshop is evidenced by the mild enthusiasm of the participants for the method. As noted in the previous section, the students in the practice exercise were "enthusiastic about the role and importance



of the scenario approach . . . (in) achieving the objectives of the workshop." Similar enthusiasm has been common when the technique has been used with a wide variety of industrial, governmental, and educational groups. It is believed that more care in describing the methods and goals of the technique would have resulted in a greater contribution of the scenarios to the workshop effort.

### Specific Comments

Listed below are a number of comments concerning the preparation and conduct of the workshop. These comments are not intended to demean the professionalism, good will, or efforts of any member of the three teams involved, but are offered to help improve future workshops. It is the opinion of the university team that shortcomings were due primarily to the short time available for planning and preparation and can easily be averted at future conferences. These comments represent a general consensus of The University of Texas at Austin workshop team. However, in consideration of NASA's expressed interest in preserving individual opinions, the separate comments of the university observers in each work group are attached as Appendix III.A.

### Workshop Preparations

1. Preparations for the Portable Energy Technology Assessment Workshop were hindered by the short time available between contract awards and workshop conduct. The time problem was exacerbated by the fact that the industry and university teams were unacquainted with each other's personnel, organization, and work plan until after preliminary contract awards had been made. To a considerable extent this time handicap was alleviated by the willingness of all parties to devote as much talent and effort as possible to the project and by the spirit of cooperation that developed among all three teams involved. The early recognition of all parties of the need for frequent personal contacts, backed

up by telephonic and written communication, contributed to the close coordination effected during the early part of the planning effort.

2. Although there has been some criticism of the lack of balance among the participants, it is felt that the sponsors of the workshop can be proud of both the quality and diversity of the participants. The credentials of the group are particularly impressive when the short time available for invitation is considered. The general guidelines for participant selection developed by NASA and the care with which the TRW team monitored their guidelines assured a broad spectrum of backgrounds and skills. Although there may be merit in the contentions of some that certain groups were not properly represented--e.g., politicians, young people, labor, social scientists, and minority groups--much of this disquiet may be due to differences in definitions. For example, to a sociologist a person from the financial world might be considered a technologist, while an engineer would not classify him as such. In any case, the body of participants was highly qualified to address the nation's energy problems and represents a valuable base for future energy planning.

3. The notebooks prepared by the TRW team were attractive, well organized, and complete. However, it appears that the amount of material included precluded careful study by many participants prior to and even during the workshop.

4. As discussed in the previous section, the

"practice workshop" was quite successful. The students were carefully chosen for their maturity, intelligence, and diligence, and the results of the practice verified their choice. The comments of the students concerning the Alternate Scenario Planning technique and the scenarios themselves were perceptive, carefully considered, and penetrating. Unfortunately, because of the short time available between completion of the practice and the conference itself, only limited alteration of the scenarios was possible. It is unfortunate that no representatives from the NASA or industry teams attended this "trial run."

#### Scenario and Potential Action Lists

1. The University of Texas team is quite proud of the set of scenarios that it prepared for the workshop. It does feel that the scenarios could have been improved if more time had been available for coordination with the TRW and NASA teams, for evaluation by outside agencies, and for re-write. In particular, it is felt that they could be shortened and clarified by more careful wording and broadened by the consideration of additional factors. Probably, more attention to financial and technological considerations would have been desirable. Also, a more detailed breakdown of projected energy demand by end use would probably have focused discussions more effectively. Perhaps most importantly, the scenarios should have had more transition information, i.e., descriptions of how the situations described in the two time "snapshots" (1985 and 1995) had come about. This transition material could have

been supported by trend diagrams and other easily visualized data, since firsthand observation would have probably been of value to workshop managers. Nevertheless, the team believes that the scenario set represents a significant step in scenario development activities and hopes that they will serve as a basis for future studies in energy and other appropriate areas. (In fact, the scenarios have already been requested by one industrial firm and one foreign government for use in similar activities.)

2. The set of potential actions prepared by the industry team is also felt to have been well conceived and carefully formulated. However, it appears that the participants were even less familiar with this information than with the scenarios. This failure is unfortunate since such familiarity would have provided an excellent common starting base for the technically and non-technically oriented participants. It is hoped that these analyses will also be used in future studies.

### Workshop Facilities

1. Although the scenic beauty of Monterey and special amenities of the Del Monte House contributed to the pleasant atmosphere of the workshop, the actual conference facilities were, at best, barely adequate. The shortage of blackboards, overhead projectors, special platform facilities and, in most cases, even conference tables caused unnecessary inconvenience and distraction. The motel, unfortunately, is not well prepared for workshops of this type. In addition,

the room accommodations were very expensive and the sound-proofing between rooms practically non-existent.

2. In spite of these shortcomings, the TRW team did an excellent job of organizing the facilities for the workshop and providing efficient, speedy, and friendly service to the staff and to participants. Social activities were particularly well handled and added greatly to the ambiance of the group.

#### Workshop Management and Organization

1. The organization of workshop activities appeared to have been very satisfactory. Although certain changes have been recommended by a few participants, e.g., use of a single scenario in the first phase, initial heterogeneous groupings, more frequent group changes, and different work themes, the value of these suggestions is not apparent.

2. As stated earlier, it is felt by the university team that an explanation of the ASP methodology both in the pre-workshop notebook and at the first morning's general conference would have significantly increased the value of the scenarios to the accomplishment of workshop objectives.

3. The lack of familiarity of the delegates of both the scenarios and the potential actions information also decreased their contribution to the workshop's effectiveness. The question of whether or not individual scenarios should be included in the pre-workshop notebooks, in actuality, turned out to be a moot point, since few of the participants

read them before the workshop. Realistically, this failure should have been anticipated and a formal method provided for briefing participants on the appropriate scenario and potential actions early in the workshop proceedings.

4. At the start of the workshop, the university team passed out to the participants a brief description of the present status and recent past of each of the factors considered in the scenarios, together with a glossary of terms and list of references used in developing the scenarios. Unfortunately, few of the participants realized what the documents represented and, therefore, little use was made of them. If these documents had been included in the pre-workshop notebook or, failing that, if their existence and significance had been properly publicized, they probably would have served to decrease disagreements on data among participants and questions about scenario projections. The value of these documents probably would have been greater if a description of the present status of pertinent technologies had also been included.

5. Few of the workshop groups seemed to have availed themselves of the data base at the workshop service center. Apparently, the participants were not actively aware of its existence or of its nature; this is unfortunate, as access to it would have prevented several disagreements and misconceptions among participants.

6. The number of observers in the work groups was probably too large and may have served as a distracting

factor, particularly when individuals entered after the discussions had started and left before they had ended.

7. The effectiveness of the chairmen and facilitators varied considerably according to their experience and capabilities. In general, both groups would have profited from a better understanding of workshop goals and procedures. For the most part neither the UT nor the TRW observers seemed to have contributed significantly to work group efficiency, although in some groups the TRW facilitators were quite valuable. In general, it was not felt that the talents of the university team were employed with maximum effectiveness at the workshop.

8. The discussion outlines provided for the workshop were not very effective in channeling discussion. Although a more formal format might have restricted the range of deliberation, it might also have helped to clarify workshop objectives and direct the efforts of the group toward meeting those objectives.

9. The choice of guest speakers at the workshop appeared to many of the participants to have been biased. Although this apparent imbalance was obviously unintentional, it was also unfortunate.

10. It was generally acknowledged by the staff and the participants that the attendees of this workshop represented a very experienced, strong-willed, and interesting group. Unfortunately, the limited time available made it impossible for everyone to be exposed to the opinions and thought processes of all the other attendees. In a few



cases, individual participants addressed everyone on their areas of specialty at general meetings. The information imparted and the interest aroused by these presentations makes it worthwhile to consider formal scheduling of such addresses in future workshops.

11. It is the opinion of the UT team that the transition from Phase I of the workshop to Phase II could have been accomplished more effectively. As previously mentioned, it is believed that a specific noting of the commonality between work group analyses and recommendations would have served as an excellent point of departure for Phase II considerations. As it was, several of the "B" work groups seemed to be unsure of what was desired of them and of how to proceed. Although this confusion was alleviated to some extent by explanations to each group by Alexander & Spraul, some groups merely repeated Phase I procedures.

#### Post Workshop Reporting and Follow-Up Actions

1. The post workshop reporting requirements for both the university and industry teams seem to be reasonable and adequate. Moreover, the plans for translating workshop results into pertinent research projects should be effective. Although not specified in the Work Statements, the announced plan of NASA to request comments on the Workshop Report from participants appears to be an excellent idea. Other positive steps to keep the participants involved as a group in energy planning efforts would also be desirable.

2. Although the university team was not intimately aware of the efforts by NASA and TRW to bring the workshop to the attention of the public, the publicity actually received did not seem to be as great as the importance of the conference would justify. Hopefully, the publishing of Workshop Reports will increase public awareness of workshop activities and accomplishments.

## Recommendations

The following recommendations are offered as suggestions for the improvement of future workshops, conferences, and similar activities. These are listed in, roughly, sequential order and not necessarily in the order of their presumed importance.

1. For future projects of this type, joint or coordinated industry-university contracts should be utilized. The concept of using government-industry-university teams to study and recommend action on complex national problems is an imaginative and promising idea. In this project, the teams have worked together in an efficient and well coordinated manner. However, liaison between participating parties prior to contract award would encourage coordinated proposals and minimize the possibility of unreconcilable project approaches.
2. If possible, more time should be allowed between project initiation and workshop conduct. This will not only permit more careful preparation, but also may enable some invitees to attend who would not be able to come without early invitation.
3. The amount of advance material sent to the participants should be reduced. Basically, it should include administrative details, an outline of program objectives and procedures including a brief explanation of the Alternate Scenario Planning technique, a brief resume of the present status of relevant technical and non-technical factors used in the scenarios, and a list of references with a brief description of each. These notebooks should be in the hands of the participants approximately three weeks prior to the workshop.
4. Greater use should be made of the pre-workshop trial run. This practice should be scheduled early enough that significant results can be factored into workshop planning. If at all possible, an observer from each of industry and governmental teams should be present at this trial run.
5. Scenarios should be carefully reviewed to stress clarity, precision, and conciseness. Adequate transitional description should be included to explain how the projected futures came about. Charts, tables, and graphs should be included as appropriate. The scenario set developed for this project should serve as a valuable base for future development projects.

6. If the ASP technique is to be used at a workshop or conference, a short (twenty minute) explanation of concepts, procedures, and purposes should be given prior to work group sessions. In addition, similarities and differences between work group plans should be identified at the end of the separate scenario phase of the workshop and recommendations offered as to how the results of this phase can be utilized most effectively in the overall planning phase.
7. A more structured format for group discussions should be provided and chairmen encouraged to channel group deliberations along these lines. Such procedures should help to target group efforts toward accomplishment of desired objectives.
8. The number of full time observers should be reduced to two--one from the industrial team and one from the university team. One person can serve as both industry representative and facilitator. The university representative should be a person who has helped in the development of the scenario being used and in the assembly of the data base. At the start of the first-phase work group sessions, the university representatives should give a brief description of the scenario to be used and explain the basis for its development; he should explain the nature of the data base and encourage its use; and he should briefly point out the organization and high points of the potential action portfolio. These explanations should serve to encourage use of the materials available. The university representative should be used to acquire data as necessary, so that the industry representative does not have to leave the group during discussions. NASA representatives should serve as regular group participants rather than as observers. Other observers should schedule their visits so that they neither enter nor leave during a workshop session.
9. If the assignment of workshop responsibilities outlined in Recommendation #8 is followed, it is probably appropriate that the university team be given the responsibility for preparing the data base and the list of potential actions in cooperation with the government and industrial teams. This recommendation in no way reflects upon the TRW efforts in these areas, but is intended to insure that the university representatives are thoroughly familiar with the data available. The preparations of these items would seem an appropriate university task because of the library and computer facilities available on most campuses.

10. When guest speakers are chosen, more thought should be given to the probable nature of their presentation to insure a variety of viewpoints. Also, some formal method should be considered for selecting delegates to speak briefly to the group as a whole on their areas of special expertise.
11. Careful thought should be given to the future involvement of the participants at this workshop (perhaps selectively augmented) as a group to aid in energy program analysis and planning. One of the key accomplishments of the workshop was the welding of these people representing a wide spectrum of experience, talent, and expertise into a cohesive and coordinated team. This team now constitutes a national resource of greater value than the sum of individual talents of its members. That resource should be utilized in addressing significant energy-related national problems in the future.

## B. SUMMARY OF CRITIQUE COMMENTS: UT REVIEW PANEL

Listed below is a brief summary of comments made in critiques submitted by a committee of fourteen people at The University of Texas at Austin. To the extent possible, the opinions of the committee members are represented in these summaries without editorial alteration by the principle investigators. Two of the people who submitted critiques attended the workshop at Monterey; the other twelve did not attend. The comments are grouped according to the seven questions listed in Appendix B. Question seven is not included in this summary. Information derived from this question is included in Part IV of this report.

Question 1: How valid were the workshop objectives in terms of feasibility, relevance, concept, applicability, etc?

The review committee evidenced little agreement regarding the validity of the objectives. Two major criticisms were expressed with high frequency. First, the objectives were considered to be too ambiguous and complex. Second, the time restraint was believed to be unrealistic given the magnitude of the data presented. The committee generally felt that a broad sample of viewpoints and information was more successfully achieved than were conclusions regarding recommendation and policy. Specific comments expressed a variety of concerns ranging from organizational concerns to matters of content. It was suggested that the proceedings

might have been facilitated by having chairpersons meet in advance of the workshop. One comment was that the generality of the goals at least provided flexibility which can be desirable in an initial session. Adequacy of the data was questioned on grounds of the failure to address the demands for acceptable forms of portable energy, and the appearance of having been furnished primarily by the energy industry.

Question 2: How well were these workshop objectives met?

Most of the positive responses to this question were, at the same time, reserved, as indicated by the fact that four persons attributed any success achieved to the scenarios and not to the workshop itself. Moreover, the workshop participants were felt to have been overly conservative in their projections. Again, the successes were primarily seen as being the broad sampling of viewpoints and the exchange of information.

The lack of success was attributed to poor control and direction. Reviewers felt that the program was allowed to drift away from the topic of portable energy. Lack of concentration on this topic, combined with insufficient preparation by participants, was believed to have led to the lack of new and useful deliberations. A frequent suspicion was that the workshop was dominated by chairpersons or "experts."

CZ

Question 3: What are your opinions of the philosophical basis of the workshop approach and of the methods used to carry out these principles?

Overall, the philosophical basis and methods were viewed favorably, and the workshop was believed useful because it allowed a variety of viewpoints to be represented. All respondents endorsed the scenarios as a workable technique for focusing discussion during the warm-up period.

Most of the criticisms and suggestions fell into two major categories. One of these questioned the adequacy of the "consensus" technique, and some elaborations regarding it were instructive. While considered necessary, consensus among participants was believed to be an insufficient goal for a successful workshop. Reviewers generally felt that alternative solutions should surface and be bolstered by strong opposing arguments, and that in this manner, breadth and innovation should precede the integration of ideas. It was proposed that fuller exploitation of the "tension-comfort" dialectic might have been afforded by tapping such areas as social psychology, game theory, decisional analysis, in planning the workshop. In this vein, one committee member suggested the "war game" technique--"since social institutions act in response to outside influences, the workshop team should be assembled into 'role groups'." Disciplinary specialties could be matched to these groups (eg., labor unions, management). Thus, in analyzing each scenario, one group could follow a designated policy and initiate action, with the other groups acting in response to



these actions. Such an approach would permit feedback and continued interchange after the workshop disbanded.

The second main category of doubts pertained to the manner of grouping workshop participants. Some reviewers were bewildered about the criterion used to obtain homogeneous and heterogeneous groups, the need for such division, and the validity of the composition of these groups.

It was suggested that the necessity for each group to react to a complete scenario with fixed levels of energy consumption was too rigid. Some groups might have been encouraged to generate different mixes of energy sources and consumption levels. Moreover, if one group had developed a portable energy technology scenario, a general session could have utilized a dialectic approach to pit this group's ideas against the constraints of the full scenario groups, i.e., those working with complete energy economies. In general, the reviewers questioned the value of so many outsiders in the group sessions, particularly "facilitators", and criticized the lack of reference and background materials.

Question 4: What is your opinion of the qualifications and balance of the participants?

The majority of the reviewers agreed that the group of participants was unbalanced and unrepresentative. The desired balance between technical and humanistic concerns was believed to have failed due to the conspicuous lack of social scientists. The reviewers suggested future inclusion of sociologists, psychologists, architects, marketing/advising

experts, attorneys, philosopher/humanists, and an elected political representative, to rectify this technological bias. It was also noted that the bibliography which was disseminated displayed a marked bias toward technical literature.

The review committee also felt that representativeness was not achieved in the area of institutional points of view, both social and political. For instance, city planners and urban transport specialists would have enabled discussion of portable energy use as it related to mass transportation policy. Similarly, the absence of participants knowledgeable in foreign energy developments, specifically the political and social dimensions involved, precluded discussion of international implications of energy consumption. A need was felt for representatives of small business, labor (specifically from the coal industry), the news media, federal regulatory agencies, environmental groups, and other "users" such as agriculturalists and industrialists.

Many of the committee members believed the workshop group to be unrepresentative of the social distribution of the population. Suggestions were made to incorporate viewpoints from "disaffected groups", young professionals, and retired and low income groups.

The foregoing review is intended to reflect the overall direction of the responses to this question, and not the entire range. Divergent opinions were expressed. One reviewer counseled against the inclusion of news media

personnel. Two felt that the suggestion of including young people was superficial and unadvisable.

Question 5: What is your evaluation of the conclusions and recommendations of the work groups?

The basic point of consensus among the reviewers was that the conclusions and recommendations, while valuable in some respects, were too general and abstract to be of direct use. It was believed that reorganization of the Proceedings Report could better highlight the fruitful recommendations that were made.

It was suggested that the following points might have been probed:

1. Details for any proposed action in terms of how long it will take, how much it will cost, and how much it will save.
2. Specific consideration of adverse aspects of proposed actions.
3. An attempt to establish guidelines for policy making.
4. Basic quantitative information.
5. Detailed information on changes in energy use patterns, environmental releases and impacts, required technological changes, land use, employment, cost of living, fuel imports, and capital costs.
6. The relationship of the portable energy issue to international realities.

7. The social implications of the portable energy problem.

Criticisms of procedure elicited the suggestion that all participants should have read all scenarios plus baseline information. Conflicting ideas within the review committee as to the types of conclusions that should have been reached indicated the lack of consistent technical data bases among the reviewers, just as the reviewers had seen in the ad hoc workshops. For instance, increased emphasis on electric vehicles was seen as a solution to energy shortages by some reviewers, but was feared to be inefficient use of energy by at least one other. Similarly, the committee members disagreed as to what the major conclusions of the workshop actually were. One reviewer saw an overriding concern in the workshop with easing portable fuel shortages by manipulating consumption in various sectors. Another reviewer focused upon the workshop's conclusion that unlimited growth in energy consumption is intolerable. Curtailment of this growth, it was noted, demands conservation and the development of clean energy sources--particularly solar--beginning now.

Question 6: What aspects of the portable energy problems of the nation do you feel were not properly addressed?

Social costs and conservation were two of the most frequent responses. Social and political matters deemed important for consideration included, once again, the need

for international cooperation in solving energy problems. Concern was expressed about existing institutions: What changes in institutional structures are needed, and what consequences will such changes have? Consideration of institutional adjustments in organization due to energy shortages and increasing demands, the relationship between price and profit, and increased government participation in both research and production efforts were all deemed necessary.

There was a general feeling that details on conservation were needed, and that a special emphasis should have been placed on concrete conservation incentives. Too little attention, the reviewers argued, was paid to the disposal of nuclear wastes, the impact of technological advances on climatological changes, and on the whole range of the human habitat.

Many reviewers felt that insufficient consideration was given to the manner in which recommendations would be implemented and to matters of legal control. What actions would the public initiate or accept? Concern was expressed over lack of attention to the interrelationship between government subsidies for research and development and the distribution of income. Some technological concerns also appeared in relations to the role of politics in energy management. Consideration of the substitution of communications for transportation was recommended. Two questions which might have been explored were how the present mix of energy

technologies can make the transition to one or more of a set of alternative mixes, and what are the plausible configurations of these future mixes of energy technologies.

In sum, a wide variety of specific suggestions emerged from this question. The overall response, however, was that many important aspects of the portable energy problem had been neglected.

### C. CONCLUSION

The fourteen reviewers represented a wide range of backgrounds, and tended to focus on specific criticisms relevant to their expertise. The lack of consensus and consistency among the reviewers is in itself indicative. One can fairly wonder whether these reviewers jointly could have gotten more to the point on concrete issues of portable energy had they been workshop participants than did the actual participants.

The principles and purpose of the workshop were generally viewed positively. The use of scenarios was seen as a commendable discussion-generating technique. The actual organization and conduct of the workshop were repeatedly criticized. These criticisms were not unexpected since the workshop concept is an infrequently used one at present. The NASA workshop was one of the first large-scale experiments of that type. Indeed, the present volume, inclusive of discussions of planning the workshop and criticisms of its outcomes, would serve as an extremely useful preparatory function for future workshop organizers and perhaps even participants.

APPENDIX III.A

INDIVIDIAL COMMENTS

on the

PORTABLE ENERGY TECHNOLOGY ASSESSMENT WORKSHOP

BY SIX

UNIVERSITY OF TEXAS AT AUSTIN

WORK GROUP REPRESENTATIVES



Commentary I.

The scenarios appear to have had a positive overall effect. For example, as some have noted, several participants indicated that this was the first conference they had attended at which technical experts and social scientists really talked and listened to each other, rather than talking at each other with no one really listening or understanding what the other had to say. This "communications breakthrough", i.e., the development of real dialogue, was attributed to the impact of the scenarios acting as a kind of catalyst. While this was a heartening response, it was not a universal one. While admitting that flaws can certainly be found in the scenarios (due at least in part to the small amount of lead-time in constructing them), I believe that they could have been of great benefit to all participants had they been used to the best advantage. That they were not so used, I think, was quite apparent.

Some participants tended to reject part or all of some scenario because theirs did not seem to represent the "most likely" future. This situation might have been avoided by making clear the point that the scenarios were designed as a planning tool with an eye toward covering as broad a range of future conditions as possible (since no one knows really what the future holds in store). None were intended to represent the "most likely" set of occurrences. The remedy for this misunderstanding would have been simple to implement. Some time (30 minutes would probably have been

sufficient) should have been devoted to informing the participants of the purpose of the scenarios. In fact, many participants eventually came to recognize the purpose just outlined, but many came to this realization quite late (as late as the third day in the group with which I spent most of my time).

It was also apparent that some participants considered portions of certain scenarios implausible. In the cases which I personally observed, such judgments were without basis in fact, but were nevertheless accepted by the group because some member of the group presented a strong negative argument. Two examples will serve to illustrate. One group was convinced by a single member that unemployment rates of 7% to 8% were absurd because such a level of unemployment would result in a breakdown of the entire social system. Why such a conclusion was reached when the 7%-8% figure is only 1% to 2% above current rates was never explained. During the Great Depression, when unemployment rates at times approached 25%, no such large-scale collapse took place.

A second example is that of the homogeneous (A) group which believed that the energy demand based on the scenario would require an improbably high level of capitalization. When the point was raised in the heterogeneous (B) group, it was pointed out by the group's financial expert that not only was the degree of capitalization possible, but also that even greater quantities of capital could be amassed without undue strain on the system.

Four general points may be made concerning the more effective use of the scenarios:

(1) Someone integrally associated with the development of the scenarios should be asked to explain at the outset the purpose for which they were written and something of the methodology involved.

(2) It should be made explicit that none of the values attached to variables were simply pulled out of the air. All were either estimates made by experts in the particular areas of concern or logical (and often slight) deviations from such estimates. (This would prevent well-intentioned but misinformed persons from persuading a whole group that portions of a scenario are implausible.)

(3) If possible, at least one person from the scenario-writing team should be placed in each group as a true participant, not simply as an aide or liaison. Such a resource person could clear up misconceptions and provide information and evidence supporting the logic and sources of scenario content. This does not mean that time should be taken up by a prolonged defense of scenarios. It does mean that the scenario resource person should be a full-fledged participant able to provide information as to sources of variable values and to challenge erroneous views such as that having to do with unemployment mentioned above.

(4) Perhaps the idea of dividing first into homogeneous groups should be reconsidered. It would have helped immeasurably to have had expert participants from a number of areas of specialization in all group sessions from the

start. The discussion above concerning capital investment is a case in point.

With respect to the workshop, I felt that the staff provided by NASA, TRW, and The University of Texas, for the most part, did an outstanding job. They responded swiftly and efficiently to requests for assistance and more information. Without in any way infringing on the participant's freedom of thought, the staff acted to keep participants focused on the problem at hand. In particular, Doug Alexander and Bob Spraul are to be commended for their administrative and substantive contributions. The TRW representative in my group, Dave Pinkerton, proved to be of tremendous help in numerous ways, especially in technical matters requiring expertise in mathematics and engineering. Certainly the secretarial staff was first-rate.

On the negative side, the mechanics of the conference organization were sometimes inadequately attended to. (Evidently, on the first day, there was some confusion in simply getting everyone into the correct groups.) Moreover, on the third day, a number of participants were still asking: "What are we supposed to do?" The problem was quickly remedied by Alexander and Spraul who paid a brief visit to each group and parsimoniously and concisely outlined just what was expected. Some participants complained, not about the quality of the staff, but about the quantity, voicing the opinion that there were not enough people to retrieve, process, and distribute information. Facilitators

were of uneven quality--some were described as excellent while others seem to have done more harm than good. Finally, the questionnaire was inadequate in that it contained no questions about the accuracy and/or utility of the "Potential Actions."

Commentary II.

The original commitment of The University of Texas research team to the NASA project specified that scenarios would be constructed as arrays of connected events leading to plausible and consistent outcomes. It was further designed that the predicted futures would emerge from historical precedence and from intensive familiarization of futurist, as well as data-projective literature. An overall evaluation of these early goals confirms that the scenarios constructed as planned were beneficial to the functioning of the workshop.

As catalysts to social and intellectual interaction among participants of diverse backgrounds and expertise, the scenarios functioned as bases for conflict as well as consensus, and for unification towards a problem-solving goal. As a sophisticated heuristic device, however, scenarios were employed differentially and somewhat inadequately among groups to the extent to which a particular group 1) was familiar with the content of its scenario, 2) accepted the professional competence and veracity of the scenario, and 3) was encouraged to utilize it.

Although workshop manuals were allegedly mailed to participants more than a week in advance, the chairman of group 5 failed to receive a copy until the morning of the first working day of the conference. Several participants who had their copies in hand admitted to giving them only a cursory glance, at best. Indeed, those group members who had ac-

tually studied the manual suffered even more confusion regarding the goal of the workshop and the extent to which the scenarios met that goal.

One member of the homogeneous group receiving the depression scenarios included an economist recognized for emphasis on measurement error existent in national statistics. His lack of acceptance of the data and insistence that no problem-solving analysis could be based on them led to a prolonged portion of the group's time in debate about social statistics, in general, rather than questions or disagreements over specific pieces of information contained in the scenario.

Groups 5A and 5B were fortunate to have a strong-willed and well-informed leader. Unfortunately, he did not fully understand the purpose of the scenario, consequently failing to give it the support it needed in the group dynamic. Indeed, it was indicated that the scenario's purpose was to "get the ball rolling" and that it could, thereafter, be regarded as unimportant to the problem at hand. Eventually, Group 5B found it necessary to utilize the first several hours of the third day constructing a "mini-most likely" scenario upon which to base policies, a scenario which was already available from the earliest endeavor of the UT research team.

The preceding highlight of problems basic to the use of the scenarios stimulates the following suggestions:

(1) The opening address on Sunday night should have included mention of the workshop manual and the role it would play in guiding the ensuing work sessions. Monday morning would begin with a general orientation session without stressing the importance of the energy crisis, per se, since it could be assumed that the participants would already be sensitized. Rather, the orientation session would reiterate the goal of the conference and the method by which energy assessment would be accomplished.

(2) Support personnel from NASA, TRW, and UT should have met with their respective group chairpersons to discuss the particular scenario with which they would work, and the manner by which the data were derived, and the importance each of the factors or parameters would play in a future energy demand pattern.

(3) The chairperson, accompanied by support personnel, would have guided the group towards understanding the scenario as a picture of one possible future for 1985-95. Acceptance of the scenario as plausible and professionally competent would have resulted in maximum utilization of the valuable tools provided in the workshop manual.

In summary, attention to the previously mentioned suggestions would be a time-saving device, eliminating much of the confusion and unnecessary belaboring over the credibility of the scenarios. Some light-hearted discussion of "role-playing" was in order for those participants who were unable to envision such futures coming to pass. Duplication



by work groups of previously-conducted research and scenario-writing could be avoided, leaving ample opportunity for challenging specific details and data not thought to be expert. With time thus economized, the scenarios, rather than being likened to a chapter from science fiction, would serve their guiding function to formal and more detailed policy proposals for NASA's future role in America's energy program.

Commentary III.

The utility and purpose of the scenarios were almost universally misunderstood and misrepresented by the participants. From the initial gathering until the end of the week, it was apparent that the participants were quite uninformed as to the purpose and manner in which the scenarios were to be used. The one, clear misunderstanding was that a great number of participants believed that their scenario was a projection of the "most likely U.S." and were unable to accept the scenario as an alternative future to be utilized as such for planning and policy-making purposes. If scenarios are to be used again, it is obvious that their use and purpose should be made explicit. In addition, it was apparent that several participants had only paid a cursory glance at the scenarios and potential actions, as well as giving only token and superficial thought to the material presented. Again, it should have been made clear that the material should have been read carefully before the conference in order to save time and confusion. In the groups I attended, the energy consumption figures at the end of each scenario were used extensively. There was a great deal of concern about the manner and methodology of generating these figures, and this methodology should have been fully explained. The primary reason I felt that such great attention was paid to this section was because, in my groups, technologists dominated and these figures were something they could relate to and have a feeling for; the

bulk of the scenarios consisted of information outside of their specialties. Thus they sought out what they understood and could deal with and ignored perhaps the most important parts of the scenarios. I felt this aided in defeating the purpose of the scenarios, i.e., giving technologists a view of the social world, of how they need to plan for the future, incorporating the social effects into their technological planning.

Summarizing the above comments:

(1) the scenarios effectively served as a springboard for the conference;

(2) the scenarios' purpose and use were misunderstood and unclear;

(3) the participants often only utilized sections of the scenarios they could relate to;

(4) the problems summarized above could have been alleviated by a much more explicit and detailed account of the workshop methodology, purpose, and goals.

TRW organized an excellent workshop based on the assumption that diverse perspectives and resultant discord would effect common interest in the conference goals. This theory of group dynamics was proved practical when an avid consumer advocate and environmentalist could be observed dining with an oil company representative in professional comradery. Especially noteworthy was the rapid integration into new group membership experienced by workshop partici-

pants. This group cohesion can be credited to the desire to aid and support evidenced in staff attitudes as well as to participant commitment to workshop interaction, which resulted in groups working even on free time.

Chairpersons were well-chosen and performed commendably at organizing the thoughts and expertise of very diverse groups of professionals and technicians. Research personnel participated to the fullest extent in all group discussions and provided much of the data back-up.

In review, I would prefer to see a workshop with such a complex problem to solve be stretched over a full week, with ample time for the development of detailed and formalized policy recommendations, accompanied by a broad statement of the position NASA might want to occupy in the area of energy research and development. Furthermore, at least one half a day should be devoted to recommendations for the implementation of such policies, including potential ramifications on the funding and organization of NASA's program. The far-reaching implications of energy supply on NASA's future should not be underestimated.

Commentary IV.

In my group, which was given the environmentally oriented scenario, criticism of the values of the variables in the scenario was held to a minimum. There was some discussion of other relevant variables not included in the scenario, but general consensus held that the picture already drawn was adequate for their purposes. The scenario was then accepted as a valid point of departure without further questioning. It was used to establish guidelines for discussion of what the social objectives concerning energy use should be, as well as to set minimum and maximum limits wherever possible on goals for energy use.

Due to the extreme concern of this particular group with the social problems involved in attempting to implement any given plan or range of plans for energy conservation and usage, little time was spent examining specific variables discussed in the scenario. Instead, discussion concerning the scenario consisted of interjections into the mainstream of the conversation as the limiting nature of various factors necessarily became a topic of concern.

In general, the handling of the scenario by my group was congruent with its intended purpose. It was used to establish an intuitive feeling of what should be done concerning energy policy, and to bring to the forefront of discussion the social limitations which must be taken into account when trying to find a satisfactory and implementable energy policy.

Concerning the workshop, I felt that it was productive in that it produced much valuable information on what can be done, but it fell short in the final synthesis of these products. There was no apparent attempt to point out similarities and differences in the final results of the groups. Had this been done, it might then be profitable to allow discussion to continue with particular focus on the major differences of opinion, if only to make salient the basic issues which are causing divergent opinions. These issues will obviously be the stumbling blocks in attempting to implement energy plans and policies.

Commentary V.

The majority of my comments will relate specifically to the scenario group dealing with governmental planning. The structure of the group was essentially homogeneous as set forth in the initial design for the conference. In addition to the designated participants, there was one NASA representative who acted as the recorder for the group sessions, a TRW facilitator, and myself who served as an observer/participant. Other representatives of TRW came in for short periods of time to participate in the discussion. For example, the initial session was attended by Dr. John Foster from TRW who acted as a major catalyst in the beginning discussions. The "outsiders" who wandered in and out during the session were somewhat of a disruptive force in the sense that their interaction with the group was not based on full knowledge of prior discussions. In other words, there was some rehashing of topics already considered which tended to delay the progressive thrust of the discussion.

The particular group in which I participated was fortunate in the sense that it had a very strong leader. He was particularly familiar with the nature of the major concerns of this scenario, since he had just completed a study concerning governmental action and the energy crisis. Because of this background he was able to define more precisely the major issues and to supplement the discussion with detailed data from his recent study. However, because he was so well informed, his presentation may have been biased. He tended

to dominate some members of the group. In the beginning he attempted to bring the group together by having each one introduce himself and give a few details of background information. These introductions served to break the ice and create an atmosphere of informality. However, as in all groups, there were dominant individuals who prevailed over the less vocal participants.

The participants were very involved with the details of the scenario and not with its spirit or concept. It was extremely difficult for them to adjust to the scenario setting and disregard disputes which each person had with some specific figures or notes within the scenario. Even the leader was not well versed on the role of scenarios. This lack of familiarity with the scenario technique contributed somewhat to the initial confusion. In this group I was able to outline the purpose of the scenario and to encourage its use as a forecasting technique in spite of disagreement with specific data contained in the scenario. Following this explanation of the scenario, the session moved forward. Observations such as this one established that it is important to have a member of the scenario-generating team or advocate of the scenario technique present in each session for those who may not be familiar with the purpose of scenarios.

Another obstacle encountered was the difficulty participants had in setting aside their loyalties to their respective agencies or firms and in approaching the scenarios



with only their knowledge, experience, and background. An example was the confrontation among workshop leaders over their opinions of the proper uses of energy and energy sources. Proponents of fossil fuels and representatives from the utility industry were especially vocal. This conflict was apparent time and time again among other participants as well.

The report which was submitted as a result of the scenario study and discussion was acceptable to the majority of the people in the government planning sessions with one or two minor exceptions.

During the next round of workshop sessions the former leader of the government planning group tended to maintain his dominant role and to present the same recommendations that were made in his group in the previous session. The transition to new groups was made difficult by those individuals who were most vocal and opinionated. Two members of the group were disenchanted with the entire program. They stated that the workshop was purely an academic exercise. As a result, they were not too enthusiastic or mentally involved in the process. Fortunately they did not represent the majority, and the interaction that occurred within their group was both educational and enlightening. However, the end result of their session was basically the same as documented by the previous group. This was clearly the result of the influence of the leader who had also chaired the previous government planning group.

Without the benefit of having reviewed the final report

and on the basis of the summaries which were given at the end of the session, I would say that the workshop/conference was a very enlightening one which indicated significant directions to the sponsoring agency. Areas of conflict were identified which resulted in recommendations for further research and development. The workshop report provided an outline which NASA may be able to use to direct emphasis or at least to develop priorities for additional research. Although the long term benefits might be difficult to identify at this time, there are obvious immediate benefits of identifying major issues and research and development areas.

Commentary VI.

The idea of several work groups attacking different scenarios was well received by the participants of the first group in which I was involved. However, the information provided to the participants regarding the "rules of the game" was inadequate. Considerable time was spent discussing whether we were constrained to accept the general features of our scenario even if they were contrary to our desires or expectations. The facilitator was of little assistance in directing the discussion to germane topics. Once the group agreed to work within the general constraints of the scenario and make only those alterations necessary for consistency, progress was quite rapid.

My first group was composed of technical people with the exception of one economist. Our backgrounds and many of our viewpoints were similar. The economist was employed by a labor union so his views were different not only because of academic discipline but also because most of the group was sympathetic to the problems of business management. However, there was sufficient diversity to generate lively discussion about the desirability of various fuels, conversion schemes, etc.

From an efficiency standpoint, the group was composed of people accustomed to making decisions based on incomplete data, so that our progress was rapid. The chairman was skillful at keeping the discussions going. The facilitator was of marginal utility.

The second group with which I worked was also composed of technical people, though they had been assigned to groups of individuals with other specialities in the first round. By the second round, people had begun to accumulate factual information and had some data to support their contentions. The group rapidly agreed on a general goal which involved reserving petroleum and gas for transportation and feedstocks while making an all-out effort to generate electricity with coal and uranium. Subsequently, electric energy would be heavily used in all sectors except transportation.

Again the group worked fairly effectively, largely because of the insistence of the chairman and members of the group rather than any assistance from the facilitator.

My overall impression was that the diverse scenarios served a useful purpose by providing a variety of alternatives to be explored. Given the experience of various possibilities in round one, it was surprising how similar the round two scenarios were. If such an exercise is attempted in the future I think that the role of the facilitator should be considerably strengthened.

APPENDIX III.B  
REVIEW PANEL'S INSTRUCTIONS

TO: DATE: 10/18/74

FROM: JOHN VANSTON

SUBJECT: Review of Portable Energy Technology Assessment  
Workshop Proceedings Report

During the week of August 25, 1974 a Portable Energy Technology Assessment Workshop was conducted at Monterey, California, under the sponsorship of the National Aeronautics and Space Administration (NASA). The workshop was the major activity of Phase I (six months) of a two-year study being conducted by NASA to develop a viable national policy concerning portable energy with particular emphasis on aircraft fuels. The first phase of the project is being conducted by a joint industry-university team: TRW, Inc. of Redondo Beach, California, is providing the industry team, and The University of Texas at Austin (UT) is providing the university team. The TRW team was responsible for the organization and conduct of the workshop and the preparation of the Workshop Proceedings Report. The UT team was responsible for the preparation of six scenarios of future events which were used as a basis for workshop deliberations. A report of this part of the university's activities is in the final stage of preparation and a copy of the portions dealing with the preparation of the scenarios will be forwarded to you when completed. In addition to developing this set of scenarios, the university team is responsible for making an independent review of the Proceedings Report. Since NASA

has requested that representatives of a number of relevant disciplines be involved in the review process, I am most pleased that you have agreed to take part in this effort.

I anticipate that the review will be conducted in three stages. First, each reviewer will be requested to study the Proceedings Report and prepare a short written critique. When this has been completed all reviewers will be asked to attend a meeting of approximately one hour to discuss their opinions of the report. Finally, an overall critique of the project will be prepared by Dr. Dudley Poston, Dr. Parker Frisbie and me. All individual reviews will be included intact in the final report to NASA.

Although the size of the Proceedings Report at first appears quite formidable, your review should be based primarily on Sections 3, 5, 6, and 7. You should also read quickly Sections 1, 2, and 4, and you will probably wish to glance quickly through the Appendices.

In reviewing the Proceedings Report I would appreciate it if you could consider the following questions:

1. How valid were the workshop objectives (pages 3-1) in terms of feasibility, relevance, concept, applicability, etc.?
2. How well were these workshop objectives met?
3. What are your opinions of the philosophical basis of the workshop approach and of the methods used to carry out these principles (pages 3-1 to 3-13)?

4. What is your opinion of the qualifications and balance of the participants (Appendix A)?
5. What is your evaluation of the conclusions and recommendations of the work groups (Sections 5 and 6)?
6. What aspects of the portable energy problems of the nation do you feel were not properly addressed? (Particular emphasis should be given to your particular discipline in addressing this question).
7. Are there any aspects of the nation's portable energy problem which you feel will deserve special research in the near future?

In addition to your responses to these questions, I would appreciate any additional comments you might have concerning any aspects of the workshop or the Proceedings Report. It would also be a great value if you could include a list of references relevant to the portable energy problem for your own area of expertise.

Although there is neither a minimum nor a maximum length for the reviews, I believe that about 8-12 double spaced type-written pages should be adequate to cover essential evaluation comments. Completed reviews should be forwarded to Dr. Sally Lopreato at the Center for Energy Studies, ENS 439 to arrive not later than November 6, 1974. Each reviewer will be notified later of the time and location of the general critique meeting. For his assistance in this project each reviewer will receive a stipend of \$200.00.



Since there is a reasonable possibility that NASA will see fit to sponsor one or more of the projects that you recommend, I would appreciate your listing on a separate note those research projects that you would be interested in conducting or for which you can recommend an investigator. If possible, give a brief description of how you would visualize the research being conducted, the number of people and amount of time that would be involved, and your estimate of the approximate cost of the project.

If you have any questions concerning this project please contact Dr. Sally Lopreato (CTX 4689), Dr. Dudley Poston (CTX 5514) or Dr. Parker Frisbie (CTX 5514).

APPENDIX III.C  
LIST OF PROCEEDINGS REVIEWERS

Dr. James R. Bright, Dean  
The Graduate School of Business  
The University of Texas, Austin

Dr. James A. Bill  
Department of Government  
The University of Texas, Austin

Dr. Hal. B. H. Cooper  
Environmental Health Engineering  
Civil Engineering Department  
The University of Texas, Austin

Dr. E. Linn Draper, Jr.  
Department of Mechanical Engineering  
The University of Texas, Austin

Dr. William W. Gibson  
School of Law  
The University of Texas, Austin

Dr. George W. Hoffman  
Department of Geography  
The University of Texas, Austin

Dr. Michael Kennedy  
Department of Economics  
The University of Texas, Austin

Robert M. Lockwood  
Bureau of Business Research  
The University of Texas, Austin

Dr. Sally Cook Lopreato  
Center for Energy Studies  
The University of Texas, Austin

Dr. Allen Mandel  
L.B.J. School of Public Affairs  
The University of Texas, Austin

Dr. Sheldon Olson  
Department of Sociology  
The University of Texas, Austin

Dr. John W. Porter,  
Aerospace Engineering  
Department of Mechanical Engineering  
The University of Texas, Austin

Dr. Philip S. Schmidt  
Department of Mechanical Engineering  
The University of Texas, Austin

Dr. C. Michael Walton  
Department of Civil Engineering  
The University of Texas, Austin

#### APPENDIX III.D

Listed below are the individual comments from the fourteen University of Texas reviewers, indicated as Attachments 1 - 14.

ATTACHMENT 1

Critique of T/A Energy Study

James R. Bright

## Critique of T/A Energy Study

James R. Bright

1. Objectives - The objectives were feasible, "good", etc. Applicability was a noteworthy choice. Achieving "balance" was a dubious goal. What does it mean? Does "balance" provide wisdom and knowledge? "Representation" is a proper goal, but "balance" is a fuzzy concept.

2. The objectives were not met well since the whole program of topics and discussion drifted away from the stated goal of "portable energy." While some elements and topics were relevant to portable energy, the focus of the exercise and virtually all group comment was on the total energy picture. Delegates did not concentrate on the trade-offs between different uses of energy (i.e. for "portable use" vs. other uses). In this sense, the workshop did not deal with its stated objectives, and must be regarded as a substantial failure in focus. It is unbelievable that the activities claimed on p. 3-3 (mid-page) were carried out, and yet the delegates did not deal with the assigned topic of portable energy. Program "concepts" was good - control and direction were terrible!

3. Given the very short planning time allowed, the design and philosophy of the exercise were very well done. Two main weaknesses were in delegate selection and topic selection. The trial run was a very fine idea. In terms of "organization", this was a very admirable effort.

4. Participants - The selection was most inadequate because of the lack of enough qualified technologists or at least recourse to their data on ---

a) Fuel cells, b) solar energy, c) hydrogen energy, d) nuclear energy (not enough members), e) geothermal energy, f) water power, g) wind power, h) tidal energy, i) coal (?) (enough participants.)

Essentially, what we got was inputs from other fields, which was fine; against a background of limited technological expertise, which was weak. Thus we got technical ignorance overlaid on inadequate breadth of technological possibilities.

The other weakness was "users." Where was expertise in agriculture, both for power and fertilizers? Was the alternative use of oil and coal energy for materials brought forth (petrochemicals)? Was there a metals and wood producer who could speak wisely and knowledgeably about their competition and positions with plastics?

The notion that young people should be included because "they will be running the nation" is a superficial suggestion. First, by the time they are running the country, they won't be young. They will have gained experience, knowledge, developed new values. The idea that their positions now will be valid then, is very dubious. I challenge their inclusion as being a valid reflection of future



attitudes, and totally reject it as adding wisdom and knowledge to technology assessment exercises (unless they have been doing good research in some part of the field).

News media as participants is another fuzzy idea. Just how are newsmen to contribute to the listed objectives of the workshop? By stretching a bit, one might argue that they will throw light on public reaction to proposed steps - but I doubt it. If you want to understand how to anticipate and meet public reaction the right skills lie in the public relations and advertising fields. Newsmen are largely reporters of sensationalism, not students of societal reactions.

5. Group Recommendations - One can only say that these reports are very disappointing since they virtually ignore their three specific charges (on p. 3-1) re portable energy.

- a. What are the issues?
- b. Uncertainties and risks?
- c. Actions now?

They all dealt with total energy and were appallingly negligent of their assignment. e.g. A typical example is on p. 53, Group A-2 ("solar energy for water and space heating" - what is the relationship of this to portable energy?) (e.g. "Phase out nuclear plants" - what is the impact on portable energy?)

Only group A-4 (bottom p. 5-5) offered (according to the report) a piece of specific data of the kind we should

have expected from all participants. Also Group B-4 had 2 such offerings.

By and large the groups came up with lots of interesting ideas and personal prejudices, with virtually no assessment of their consequences and 2nd and 3rd order impacts, and no evidence to support their ideas. e.g. Solar energy - how much energy, etc. will be consumed in developing and using solar energy? What does this do to portable energy? E.g. (bottom p. 6-11) Apparently the delegates are uninformed of Netscherts' very detailed electric car scenario for 1985. At any rate what is the electric supposed to do for energy conservation? Impact of demand for lead? Generating capacity, etc.?

Other shabby thinking is exhibited on p. 4-14, first paragraph. "Only by ... phasing out present plants can we phase in solar, geothermal, or anything else...." What is the evidence for this? Every other new form of energy has historically been phased in (including geothermal) since 1900(?) in Italy and N.Z., oil shale in Nova Scotia and Scotland. (I seem to recall).

It is evident that this group (A-2) can be regarded as a factual failure or a great social success, since the group biases were totally in control, and no facts were offered to demonstrate some of their wilder claims. (e.g. that multinationals are beyond the legal reach of any single government.) This statement is hardly supported by the fact that

General Motors, (USA) is totally controlled and responsive to the USA laws on pollution control, etc., to Australian laws on the same, etc., etc.

Perhaps this is the real merit of such a group - to display the non-factual, emotional position that we will experience in years to come.

There are many fine ideas in the recommendations. The weakness lies in the lack of technology assessment of these ideas.

6. Neglected topics - It is especially surprising that no groups seemed to address the vigorous legal control of energy consumption. Suppose taxes of 30¢/gal. were implemented? Suppose vehicle weight was cut to 2000 lbs.? Suppose each person was limited to so many gallons, etc., etc. Suppose oil search off Delaware, Maine, etc. was insisted upon by Federal Government? Suppose every dwelling had to meet certain insulation standards?

7. Special Research

a. We need to study the manufacture, design, and operation of the automobile, appliances, housing, etc. as total energy consuming activities. A critical evaluation might reveal important improvements and controls to conserve energy. NASA would be ideal to make such studies.

b. A really massive effort on solar energy is needed.

c. The technique of extracting energy at small temperature differentials could be tremendously rewarding in

many energy systems.

d. Laws and taxes to reduce energy consumption should be studied.

### Critique Conclusions and Summary Suggestions

1. The exercise was nicely organized, but direction and control were so bad that the workshop totally failed to deal with portable energy.

2. The "relevant topics" and "Factors Considered" were too broad and aggregative. They also omitted key items.

e.g.:

a. What are the sources and consumption of U.S. energy over the past 10-20 years, with indicated trends? Lack of this data base lies behind the uninformed opinions and suggestions of delegates.

b. There was no data or understanding of alternative uses of coal and oil for petrochemicals.

c. Air cushion vehicles were mentioned but not hydrofoils or dirigibles!

d. Where was data and knowledge of the various technical alternatives? e.g. tidal power, flywheel energy storage, etc., etc.

3. The delegates made little attempt at assessment of their own proposals. It was merely a "one-stage" reaction, and there was no development of the consequences of the various proposals.

4. The delegates seemed to have the idea that they were to describe an "ideal world" rather than to examine the consequences of the various possibilities before the nation.

5. Probably there should have been "researchers" to take ideas from the delegates, collect the facts, and then report back to the teams.

6. It now occurs to me that it would have been useful for one team to prepare a real technology assessment of each other team's scenario proposals.

7. Delegates need to be taught how to do an assessment.

8. There is a lot to be learned about the use of scenarios from this exercise. In terms of technology assessment the results are feeble.

9. It was a mistake to leave the operational workshop in the hands of an organization that is not familiar with the scenario concept. The responsibility should have been in the hands of some one person or agency familiar with staging group discussions, and also familiar with the technique. Who "invited the delegates to abandon the scenario at will?" All this did was to lead people back to describing a future that appealed to them.

ATTACHMENT 2.

THE PORTABLE TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

A Review

James A. Bill

### An Assessment of an Assessment

The following assessment of the Portable Energy Assessment rests upon an imperfect information base since the author's only source of evaluation is the proceedings report. Among other things, the report does not provide a history describing the inception and development of the idea for the project, transcripts of the actual proceedings, or information defining the area of expertise and research specialty of each of the participants. As a result, points raised in this review may not, in all instances, reflect the actual realities of the situation.

The following commendatory comments are sincere while any criticisms are proffered in a constructive spirit. Social scientists seem congenitally prone to criticize and condole rather than to commend and congratulate. In this review, I will do both.

### Workshop Objectives

The objectives of the workshop as presented at the beginning of the report are extremely broad, e. g., "to somehow tap into a comprehensive sample of information. . ." and "to come up with some agreement as to the key issues. . ." Even the more specific follow-up questions are broad in scope and are framed in terms of general "issues," "areas," and "actions." Goals framed in these terms bordered on vagueness and invited an admitted confusion on the part

of many of the participants. In short, the objectives were not sharply focused nor were they specific enough to permit the conferees to grapple with them with a confident directness. This somewhat general and vague nature of the stated objectives is not, however, necessarily a negative feature. The participant confusion occasioned by the vagueness of goals is offset, in this reviewer's opinion, by the inherent strengths of the approach. Indeed, there are reasons why such rather general objectives would be preferred within the context of this workshop.

It is admitted that this workshop was an "experiment." Experiments bound into constricting and rigid (as opposed to rigorous) formats seldom yield meaningful results. By stating the goals of the workshop in general terms, the conference organizers were providing the participants with maximum flexibility. The approach was designed most probably to permit a maximum of intellectual elbow room in a no-holds barred atmosphere. In an initial workshop confronting a problem of the significance and complexity of this one, it is better to risk vagueness than to risk the closure of ideas. Subsequent conferences can define and focus their objectives now that the crucial preliminary workshop has opened the various avenues of exploration.

As stated, the objectives were by and large realized. The



mountain of information on the energy situation was tapped into and a general consensus was reached concerning key issues. Besides this, a checklist of more specific conclusions and recommendations was developed. The judgement of the manner in which the information was absorbed and the quality of the recommendations, however, is reserved for a later section of this review.

### The Organization and Format

Perhaps the greatest strength of the workshop proceedings is contained in the organizational outline and intellectual format. Although this outline and format was not always implemented, it nonetheless contained a number of very fine ideas. There is repeated recognition of the dramatic necessity to achieve four goals in this respect: (1) to maximize the opportunity for a flexible intellectual approach; (2) to invite differing opinions and to establish deep dialogue; (3) to be throughout sensitive to manners and methods of improving procedure; and (4) to develop a truly interdisciplinary approach.

As was mentioned above, the general nature of the conference objectives did promote flexibility. Despite one glaring area of omission,<sup>1</sup> an extensive array of subjects and topics was discussed. The report also indicates that the desire to tap intellectual

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<sup>1</sup>The international perspective to be discussed below

differences (the concept termed "differentiation and integration") was quite effective. This is seen most dramatically in the strong and contradictory feelings that developed concerning the issue of nuclear power.

Most impressive is the invitation to self-criticism which is taken seriously in a genuine attempt to improve the process and, ultimately, the result. The report contains within itself a number of critical commentaries and frankly identifies a number of serious problem areas. And, of course, this internal kind of critique is now further buttressed by a series of independent outside evaluations. This kind of non-defensive attitude is refreshing and unusual. It has been implemented and can only result in a strongly improved final product. Unfortunately, the excellent ideal of an interdisciplinary effort is not realized in nearly the same way as the above three objectives and merits separate discussion.

The intellectual format of the workshop is innovative and quite adequate. The division into A groups according to shared areas of expertise and then into B groups formed on the basis of particular problem areas ensures both an intensive and extensive interaction among participants. If applied correctly, the Alternate Scenario Planning Technique can be quite effective. There is, however, one aspect of the Group A organizational format that is unclear. Group

A panels were organized not only according to common disciplinary/occupational characteristics but also according to particular scenario categories. It is not at all evident to me how the disciplinary specialty was matched up with the scenario type. It is nowhere explained how these matches were determined. I would suggest, for example, that Group 2 would be as well qualified to confront Scenario 6 as is Group 6. Group 5 would perhaps be better able to handle Scenario 1 than would Group 1. And so on. In the absence of any explanations for these important pairings, the reviewer is left in a state of rather uneasy bewilderment.

#### The Priority of Participants

It is directly or indirectly stated a half dozen times at the beginning of this report that a special effort has been made to recruit a balanced mix of participants for the workshop. Much is made of the desire "to achieve a balance between technical and humanistic concerns" (p. 3-1). In this reviewer's opinion, this objective is of extraordinary importance to the success of any significant study of portable energy. Apparently, the workshop organizers agree with me. A careful study of the proceedings, however, raises considerable doubt in my mind whether this goal was realized in fact. My doubts are based on the following observations.

Social scientists seem to have been grossly underrepresented.

As usual, they were lost in the shuffle of engineers, technicians, and professional administrators. According to my calculations, there were six social scientists sprinkled among the workshop participants. Of these six, only two qualify as scholars active in teaching, theory, and research. All the rest are associated with particular research institutes where they orient themselves to specific practical problems and the applications thereof. Thus, the bias runs not only against social scientists but also against a particular kind of social scientist, i. e., the individual most involved in broad speculation, general social process analysis, and theoretical investigations. The slack was not picked up by philosophers or humanists as not a single representative of either category was in presence. And in a project in which there is a recognized need to consider the political dimensions which surely are a dominant force determining energy policy, only one political scientist and one public administrative specialist actually participated in the proceedings.

The strong technical slant of the workshop is reflected in the 465 item bibliography appended to the Proceedings Report. Outside of a handful of general articles on the energy crisis and five pieces on international issues, there are 12 references to the economics of the problem, 11 selections referring to the

environmental situation, 1 entry with a military emphasis, 1 listing of a sociological bent, and 1 article stressing politics.<sup>1</sup> The rest of the bibliography focuses upon technical issues that range all the way from slurry pipelines to the Garrett Flash Pyrolysis process.

Although the report itself recognizes the absence of representatives from the news media, working politicians, and youth, there is no apparent recognition of the severe underrepresentation of social scientists. As a social scientist myself, I may be open to the criticism of professional bias. But apparently a large number of the workshop participants felt the same way. This is reflected in their final critiques of the conference. There were nine separate comments indicating the desire for a greater representation of social and political scientists. Four other individuals (presumably of technical background) saw fit to praise the inclusion of some social scientists. One participant indicated that he enjoyed the "interaction with non-technical types."

The question raised here concerns the relative absence of social scientists and the resultant lack of indepth discussion of relevant sociopolitical topics. One example concerns the somewhat

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<sup>1</sup>The sociological reference is "Highway Statistics, 1972" while the lone political entry endures the title "Administration of the Federal Coal-Mine Safety Act, 1952-62."

ethnocentric tone that pervaded the atmosphere of the workshop.

### The Problem of Parochialism

In an increasingly interdependent world, one would think it impossible to undertake any serious study of portable energy without viewing the subject from an international perspective. Yet this seems to be precisely what occurred in the Portable Energy Technology Assessment Workshop. At best, the international scene is assumed to be x or y. At worst, the rest of the world is simply not considered in the calculations.

The only panel that seriously but briefly considers some of the international ramifications of the problem is Group B 3. Unfortunately, and somewhat mysteriously, Group B 3 is the only group of the 12 which offers no conclusions nor does it tender any recommendations. Instead, its conclusions and recommendations are imputed to be the same as those of Group A 3. A close reading of the findings of A 3 indicated little that is relevant to the deliberations of B 3. Most especially, the modicum of international sensitivity reflected by Group B 3 seems lost in the important summary statements of Group A 3. Embedded in 25 conclusions and recommendations of Group A 3 is the statement that "the world energy picture must be considered." But by whom? Apparently not by the members of the Workshop.<sup>1</sup>

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<sup>1</sup>Group B 4 also apparently touched on certain international aspects of the problem. The only indication that this may have been so, however, is a brief reference under a category entitled "Items of Interest" which appears in the Conclusions section of the report. Here it states that Mr. Wilson Harwood made an oral presentation and compiled notes entitled "Importation of Oil and the Arab's Oil Policy." And that "these notes are included in Section 4 above." A thorough search of Section 4 and, indeed, of the entire report has failed to turn up any such notes. It seems that the few instances where international issues were discussed have been unaccountably deleted from the Proceedings Report.

Further evidence of the strangely parochial context of the proceedings concerns the overall conclusions and recommendations. One of 66 general conclusions reached by the 12 study groups has any reference to the world energy picture. One of 61 general recommendations made by the 12 study groups has any direct relation to the international realities of the portable energy issue.

Unlike the problem of balanced participation where the report reiterates the desire for a technical/humanist mix, there is no reference to the need to be sensitive to the international nature of the problem under examination. There is no statement that all nations of the world are in this together and the way one country decides to confront its energy issue will inevitably effect other countries. At a time when the world continues to shrink in size and nations are bound together within a complex network of political and economic relationships, can we ignore an international approach? Can any nation be self sufficient in energy and for how long? If so, does that mean that failure elsewhere will not have an effect everywhere? What about cooperative international ventures? The question of world stability and instability? The issue of collapsing allies and future wars?

These kinds of questions need to be considered. If they are not, then one must provide reasons why not. The argument advanced here is that the attainment of self sufficiency in energy is linked intimately to the international social, political, and economic system. The technical and political investigations of how and why need to be initiated.

### Conclusion

The Portable Energy Technology Assessment Workshop represents a fine initial attack upon an extraordinarily complex problem that cuts across all systems by which man organizes his life. Conceptually, organizationally, and procedurally, it has been innovative and productive. With a bit more attention to the human, social, and political dimensions of the problem along with a considerably broader geographic perspective, this developing study could well yield results and recommendations of incalculable significance.



ATTACHMENT 3.

REVIEW OF PORTABLE ENERGY TECHNOLOGY  
ASSESSMENT WORKSHOP PROCEEDINGS REPORT

Prepared by

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Ames Research Center  
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## Introduction

A Portable Energy Technology Assessment Workshop was conducted during the week of August 25-30, 1974 at Monterey, California by the University of Texas at Austin and TRW, Inc., of Redondo Beach, California, under the sponsorship of the National Aeronautics and Space Administration. The purpose of the Workshop was to provide background information regarding transportation energy use patterns based upon different alternative scenarios of the future. Future energy use patterns for transportation were of particular interest to the National Aeronautics and Space Administration in terms of aircraft and spacecraft fuel requirements. Six scenarios of the future between 1975 and 1995 were developed regarding the technical, environmental, economic, social and political aspects relative to alternative energy supply and demand patterns.

The Workshop was asked to develop the environmental, economic, social, technical and political aspects related to six different scenarios based upon futures with primary interest on economic growth, environmental protection, social and economic equality, economic dislocation, technological development and international disarray. Energy demands were estimated for 1975, 1985 and 1995 for each of the scenarios which ranged from 70 to 195 quadrillion Btu per year, which corresponded to varying conditions as given.

The participants of each scenario session were then asked to evaluate the plausibility and impacts of each situation for the future based upon different conditions of population, urbanization, employment, economics, social equality, transportation, environment, education and international relations.

### Workshops

Each of the report scenarios were evaluated in terms of plausibility, consistency, relevance and parallel development. The six scenarios of economic growth, environmental protection, social equity, economic dislocation, technological breakthrough and international disarray were all found to be plausible though in varying degrees. It is probable that a combination of all of the above may be found at varying times in the future. The two most plausible alternatives for the immediate future were economic dislocation and international disarray, both of which have recently occurred because of the recent oil embargo and oil price increases. The effort of the United States to develop energy self-sufficiency through Project Independence would be a recognition of this fact. Of greatest desirability but of lowest probability would be the technological breakthrough scenario because of the unwillingness or inability of public and private organizations to commit the necessary resources, money, equipment, and most important, manpower.

The major objectives of the Workshop was the development of background information regarding the impacts upon energy use of varying scenarios of the future in order to establish national policies, particularly for portable energy. The above objectives were met with varying degrees of success by each of the groups in their development of the impacts of future energy scenarios. It was felt by the author that the best energy scenario development was by the group regarding environmental concern because it presented the most thorough, complete and quantitative information regarding the technical, environmental economic, social and political impacts of their proposed policies. It was unfortunate that the other groups did not, in varying degrees, present the quantitative information to the same degree to provide a uniform interpretation of future developments and policy impacts. Some scenarios presented too much general information and direction without sufficient factual information for uniform interpretation of policies to be made.

One factor almost completely overlooked by all groups was what impact these future energy scenarios would have on the freedom of movement, life styles, living and working habits of people. It will not be possible in the future for the United States to maintain its suburban-urban living patterns with massive "megapolitan sprawls." People will have to live near their work and their freedom of movement will be reduced. Land use patterns will be dramatically changed by necessity where the small towns will become large

where energy production and primary manufacturing and forming will take place. The major cities should be caused to become smaller and more densely populated, with self-sufficient clustered suburban communities. The social, political, psychological and physiological risks of these policy alternatives need to be addressed in greater detail.

The energy scenarios were all very relevant to both the near and long term future. The most relevant scenarios for the immediate future were the economic dislocation and international dissarray for the period of 1975 to 1980, the situation we are now in the midst of. Government action may be taken to produce economic and social equality by raising the living standards of the disadvantaged. Unfortunately, the manner in which equality may be brought about is by continuance of present government economic policies to make everyone poor by excessive inflation, which will drastically reduce personal use of automobiles and pleasure travel.

The scenario of continued economic growth will not be relevant for the near or distant future because of our domestic depletion of energy and mineral resources. The two most relevant scenarios after 1985 were the environmental protection and technological breakthrough alternatives. However, these alternatives would require a very alert and capable national leadership, major reductions in the power of certain special interest groups, and a major commitment to technological progress. The environmental scenario placed great faith in solar power, which will become relevant for small scale uses but not large scale uses. Major

research and development needs to be devoted to environmentally-effective uses of coal so that our country does not rely only on nuclear power.

The group reports were not entirely consistent in their formats and most lacked sufficient quantitative information to enable uniform interpretation of impacts to be made. All of them should have presented detailed information on energy use pattern changes, environmental releases and impacts, and technological changes required. Information on land use, employment, cost-of-living, fuel imports and fuel use patterns was needed in more detail. The capital costs and material requirements for alternative energy sources needed to be developed more thoroughly, as well as the operating energy conversion efficiency of alternative energy supply modes, because some entail substantial losses in extraction, conversion and transportation.

### Conclusions

The sources, options, risks and impacts of various portable energy alternatives are described fully and in detail for those related to oil, which is our present major energy source for transportation. It would be necessary to develop a series of priority uses for each of our major energy sources of coal, oil, gas, nuclear, solar, geothermal and other methods to accurately establish energy use prior-

ities in terms of transportation, electricity, industry and space heating. Future energy policies should recognize that our two most readily depletable domestic energy sources are petroleum and natural gas and our two most readily available energy sources are coal and nuclear power.

Petroleum will become too valuable a resource in the future for general use as a fuel, particularly for ground transportation operations. Priority uses for petroleum should be as a feedstock for the petrochemical industry and as a fuel for aircraft, the military and in agriculture where other energy sources are not readily suitable. Additional uses for petroleum included as a fuel for inter-city trucks using intermodal transport and for automobiles in nonurban areas. The use of distillate and residual fuel oils as an energy source for electric power generation should be phased out as rapidly as possible.

Natural gas will also become too valuable for general use as a fuel for electric power generation, where its use for that purpose should be phased out as rapidly as possible throughout the United States, including Texas and California. Priority uses for natural gas should be in fertilizer manufacture, as a feedstock for the petrochemical industry, and as a fuel for space heating in residential and commercial heating. Its industrial usage should be restricted to specific material drying applications where other energy sources are not readily suitable.

Nuclear power will become increasingly important in the future in terms of fission, fusion and breeder reactors, primarily as a means of electric power generation. However, it should probably not be allowed to exceed 50 percent of the total national electricity generating capacity because of potential problems with high initial capital expenditure, security, sabotage accidents, operating shutdowns and possible adverse environmental impacts associated with thermal waste discharges a radioactive reactor spent waste transport, storage and reprocessing and the major energy requirements associated with spent fuel reprocessing.

It is the author's opinion that coal will become the nation's most important energy source in the next 10 to 20 years, with nuclear power in the 20 to 30 years following, and then solar power afterwards. Coal is important as the energy source for electric power generation in both mine-mouth and market-proximate plants by means of direct combustion in conventional boilers and future fluidized bed combustion units. Major adverse impacts of coal extraction include land disruption and ground and surface water contamination during surface mining, and land subsidence, miner safety and ground water contamination with deep mining, as well as potential strikes by coal miners. Environmental air pollution problems associated with coal combustion are sulfur dioxide emissions and subsequent sulfate aerosol formation downwind to cause acid rainfall, nitrogen oxides with sub-



sequent introcate aerosol formation, particulate emissions, and trace metal discharges such as cadmium, mercury, beryllium, copper and selenium. All of the above will require research and development in addition air pollution controls.

Coal conversion to other fuels by gasification of liquefaction and as a feedstock for chemicals manufacture was given considerable emphasis in the report. Coal gasification is suitable for in situ development as low-Btu gas for direct combustion at mine mouth electric power plants, and as with Btu gas by methanation for pipeline transmission for subsequent space heating, fertilizer production and petrochemical feedstock use. Coal liquefaction for conversion to methanol or Kerogen (synthetic crude oil) will also be useful, though on a more limited scale than presented in the report. Coal may also be used as a feedstock for the petrochemical industry in addition to coke production in steel manufacture. ?

Too much emphasis has been placed in the report on coal conversion to other fuels because of the lower overall energy conversion efficiency as compared to direct combustion, where it is necessary to optimize energy input to useful work output. An additional reason is that it will not be possible to locate many of these coal conversion plants in water-short areas of New Mexico and Wyoming because of possible depletion and disruption of ground water flows and supplies, which would jeopardize agricultural operations in the Colorado and Missouri River basins and

in the general Midwestern United States. There is a definite tradeoff between energy production and food production with coal which will necessitate minimum water consumption and maximum land reclamation. Coal gasification and liquefaction represent consumptive water uses by inclusion as hydrogen in the products, as well as process and cooling waters. It may be preferable to transport the coal to more water-abundant areas such as Houston or St. Louis for subsequent conversion to gases or liquids.

Major points overlooked in the report were the environmental, economic and material tradeoffs associated with long distance coal energy transportation by railroad, pipeline transmission. Transportation of coal by railroad has a higher overall energy conversion efficiency than direct electricity transmission (except superconductors) or gasification, but required slightly more energy than slurry pipelines. A major environmental advantage of railroads over slurry pipelines is that no water is required so that it is not necessary to pump water from the water-scarce Rocky Mountains to the water-abundant Midwest.

It would be particularly desirable to ship coal from the Rocky Mountains to Texas, the Midwest and Southeast by electrified railroad. The coal itself would then be the energy source where it would not then be necessary to use scarce petroleum to haul plentiful coal. Electrified railroad transport would also not reduce the net heating

value of the coal like slurry pipelines because water would not need to be added.

It will become particularly desirable in the future to shift energy sources from increasingly scarce oil and gas to relatively abundant coal and nuclear power, which is a feasible alternative for both industrial and transportation operations. All possible energy consumption should be shifted to electricity uses where domestically available coal, nuclear or geothermal power may be readily employed to minimize the need for petroleum consumption as a drain on the national balance of payments. Intercity freight and passenger transportation should be shifted wherever possible to electrified railroads, with maximum feasible use of intermodal systems such as trailers on flat cars (TOFC), containers on flat cars (COFC), and automobiles on flat cars (Autotrains). Maximum modal shifts are necessary in intra-city passenger transportation from automobiles to electric buses, electrified rail rapid transit systems and battery and fuel all powered automobiles.

As mentioned in the report, much emphasis will need to be placed on railroad transportation in the future for both freight and passengers. Major upgrading of railroad service standards will be necessary, management philosophies and labor policies must be changed, and institutional restraints regarding noncompetitive practices must be eliminated. Efforts of railroads to prevent technological changes such as slurry pipelines should be overcome by legislation if

necessary to encourage competition. Rate policies of the Interstate Commerce Commission must be changed which encourage inefficient operation, and labor practices must be altered which encourage excessive numbers of employees. There will be a need for large numbers of well-trained personnel to operate railroad systems in the future from both technical and management standpoints.

### Research

Several areas are in need of additional research regarding the development of rational and effective national energy policies.

1. Additional scenarios need to be developed regarding specific fuel usage patterns for petroleum, natural gas, coal, nuclear power, geothermal and other uses corresponding to different economic, political and social conditions in the United States. The technical manpower, capital, material and environmental impacts need to be evaluated specifically and in detail to provide information for subsequent policy decisions.
2. Research needs to be performed regarding the long distance transportation of energy from coal by means of electrified or diesel railroad, slurry pipeline with water or oil, gasification, liquefaction and direct transmission through conventional overhead or semiconductor systems. Major items of information to be delineated include

capital, material, manpower, water use and operating energy requirements for alternative systems, environmental impacts and corrective measures to be taken for air, water, land and noise pollution, and overall system energy conversion efficiencies.

3. Energy consumption requirements need to be developed for alternative electric transportation systems in terms of Btu per passenger-mile for electrified intercity freight and passenger railroads, electrified intracity buses and rail rapid transit systems, and battery and fuel cell powered electric cars. The information would need to be gathered under a variety of operating conditions for existing systems, plus projections made for new systems to be built in the future.
4. Major research needs to be performed in the areas of air pollution controls for sulfur oxides, nitrogen oxides, particulate matter and trace metal emissions from coal-fired power plants. Sulfur oxides emission controls which do not employ calcium-based scrubbing must be developed to minimize sludge disposal and lime depletion problems. Nitrogen oxides emission controls are needed which employ liquid scrubbing and suitable methods for trace metal emission controls may be necessary. Fine particulate emission controls must also be further refined from present tech-

nology.

5. Potential overall environmental impacts of conversion of intercity and intracity transportation to electrified systems need to be investigated in detail to facilitate quantitative policy decision making, particularly with regard to air pollution and noise pollution.
6. Overall national environmental impacts need to be developed for energy source shift policies in terms of air pollution emissions, thermal waste heat discharges, water use patterns and possible climatic changes. Of particular concern are acid rainfall in cities, rainfall pattern modification and possible contamination of agricultural irrigation waters. The author is willing and able to work on any or all of the above research project areas.

ATTACHMENT 4

REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

E. L. Draper, Jr.

## REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT WORKSHOP PROCEEDINGS REPORT

E. L. Draper, Jr.

### I. Workshop Objectives

The stated workshop objectives involved the sampling of opinions from people with a variety of backgrounds or questions related to portable energy and the amalgamation of those opinions into recommendations for action. While such objectives are clearly important for the pursuit of a future policy satisfying all or most segments of society, it is not clear that recommendations from a one week workshop could be logically consistent. Despite time limitations progress toward meeting the objectives could have been relevant and the output valuable. The concept of a workshop is a good one in that it allows instant feedback on a wide variety of suggestions. There appear to be several shortcomings of the workshop as held and these will be stated below.

In summary, the concept of a workshop is a good one, the objectives were desirable ones, the implementation could be strengthened in future efforts.

### II. Attainment of Objectives

The stated objectives were met only partially. As can be seen by an examination of the material in sections 4 through 7, most of the effort was spent on the general energy problem rather than on portable fuels. While the total energy question is a very serious one and portable fuel supply is a strong function of policies related to boiler fuels, etc. the



broad issues addressed are certainly too much for a one week workshop.

Many important issues such as car pooling, mass transit, etc., were dealt with only cursorily because attention was devoted to such issues as the desirability of nuclear power plants.

It is the strong opinion of this reviewer that the results would have been significantly enhanced by attempting to provide each participant with a more specific statement of the objectives and method of operation. The statement on page 3-3 of the proceedings that a couple of people did not know the purpose is reflected in the group reports. It would appear that many more than a couple were in this category.

On the same page, part d., the statement is made that the specific process or procedure for dealing with scenarios was not stated. In a format in which time is limited a very significant fraction of the effort can be devoted to "getting organized". A little more direction would probably have been valuable.

The awareness of the energy situation varied widely among the participants before the meeting. While this is inevitable in a group drawn from many disciplines, it would have been useful to provide each participant with a written summary of the existing energy situation. Some of the participants were able to recommend from factual information while others spoke based on supposition or prejudice. In this regard it would have been useful to begin with half a day of status reports from qualified speakers.

In summary, the objectives were met in the sense that a reasonably good sample was obtained and suggestions were made for action. I feel that more specific and meaningful suggestions to the portable fuel problem could have been made if the information provided to the participants and the method of operation had been altered.

### III. Workshop Approach

The workshop idea appeals to me because it allows representation of a variety of viewpoints rapidly. As stated previously, I think this workshop could have been strengthened by the addition of written background materials and talks early in the week. The ideas conveyed by the luncheon speakers were interesting but almost too late. Participants would have profited materially by additional information specific to portable fuels.

The "two group" idea was a good one but too often the supposedly homogeneous groups were quite heterogeneous and the desired reinforcement of position did not occur. I know for sure that this occurred in group A-4 in which the UAW representative, Mr. Nulty, had a strikingly different viewpoint from the others. I am told this happened in other groups as well. I suspect that this sort of heterogeneity is inevitable unless the organizers know each participant personally.

The division of time among the various activities is not unreasonable, the size of the groups about right, etc. It was my experience that the facilitators did not perform effectively.

### IV. Evaluation of Participants

The participants included were excellent. As noted in the report there were omissions including politicians, press, and young people. I also feel that there was inadequate representation of labor and that retired people and low-income people should have been included. The latter two groups living on low and/or fixed incomes will be affected in dramatically different ways from affluent citizens if transportation fuels are either not available or are available only at high prices. These groups are also

apt to have more immediate knowledge of available mass transit systems than those present and they should have valuable input or implementation of future systems. I recognize that it would be difficult to locate people in these categories who meet the first five criteria on page 3-5.

In summary, I think those who participated were good choices. At the same time, I feel several important groups were omitted.

#### V. Conclusions and Recommendations

As stated above, the conclusions and recommendations, while interesting have little to do with portable energy. They are, with the exception of vague conservation and exploration, related to suggestions easing shortages for portable fuel by transferring petroleum from other sectors to transportation and augmenting existing nuclear and coal installations for electricity generation.

A rather simple calculation will show that even if all oil and gas are diverted to transportation by 1985 (very unlikely) there will be an inadequate supply and there will certainly not be enough by 1995. It seems to me that we must dramatically change our consumption patterns for portable fuels; this idea is not forcefully expressed in the conclusions and recommendations.

I would have expected much more attention to be devoted to increasing man-miles/gallon, electrified vehicles, synthetic fuels, etc., rather than simply trying to divert fuels from other sectors. Even the most enthusiastic substituters and conservationists must recognize that transportation will continue to be a big business and petroleum is in limited supply.

## VI. Omitted Aspects

Many of the omitted areas were alluded to in section 5. Specifically, I think attention should be paid to non-petroleum driven vehicles and augmentation of portable fuel supplies by coal or oil shale based processes. In addition special emphasis should have been placed on concrete conservation incentives.

## VII. Future Research

It seems to me that the portable energy research should be addressed to short and long term problems. The short term activities must deal with about the next fifteen years and should attempt to provide fuel for conveyances similar to today's cars, trucks, buses, and airplanes. Such research should focus on the feasibility of nuclear powered ships, synthetic fuel manufacture, increased man-miles/gallon (either through better mass transit systems or more efficient private automobiles), synthetic fuel manufacture from coal or oil shale, and any other conservation or augmentation schemes for petroleum. I suggest that very little has been done to assess our portable energy situation other than to suggest not using petroleum as a boiler fuel.

In the longer term, I think we will necessarily use fuels other than petroleum for all transportation except rapid passenger transit by air. Autos, buses, trains, etc., will use abundant fuels such as uranium and coal in the form of electricity. (In the very long run, fusion). For this reason we should address problems of power plant siting on some basis other than one at a time. We must consider "power parks" and address siting, fuel

transportation, and power transmission questions. We should continue to support heavily those energy projects with large potential pay-off such as the breeder reactor, fusion, solar for individual units (not electricity production) while placing relatively less emphasis on low potential impact projects such as wind, tidal, etc.

also sense that the organizers feel that some participants were not equipped to provide data of a technical type, yet they were asked to consider and evaluate such data. There seems to be a problem in asking a generalist to arrive at specific solutions to complex problems based on such a mass of data. (p. 3-14)

I view as one of the major problems obtaining a sound factual basis upon which to move. In terms of feasibility, relevance and applicability, there is not time, nor am I equipped, to judge the validity of the background information furnished the participants; however, I am skeptical about it because most of our information about energy is furnished by the energy industry, and it is not surprising that it supports those actions which the industry favors.

If the workshop objective of a tapping a sample of information was to obtain new facts about portable energy problems, then it would appear that the goal was not achieved. The groups generally did not challenge the facts which were given to them, nor did I sense that there was much added to what was fed to each group. Question 3 of the critique sheet (p.D-1) seems to indicate by its four parts that it was not factual information you wanted but rather "approaches," that is, methods for using the data as supplied. If this is what you mean by "information," then I concede that something was achieved, but because of the scope of the workshop, the approaches were very broad and indefinite; consequently recommendations were general and vague. The time given for the task was much too short to expect feasible, relevant approaches to the energy problem. The brainstorming produced very much the suggestions that have been made by various

other groups at various other times and I do not feel that any of these approaches have been reinforced or expanded by the work of the groups; nothing new, no real contribution to the solution of the problem.

#### PHILOSOPHY

The philosophy of the workshop is difficult to fault. Intelligent, concerned, articulate people discussing a common problem is an excellent concept. (p. 3-5) The method, ASP, which conceives the existence of several possible futures and requires forecasting and choice, would seem to require the acceptance of a future that a participant basically may not believe in. He or she might intellectually grant a possibility, but the basic disbelief would remain, and the participant forced to discuss hypothetical and unreal issues may tend to relieve himself from responsibility for his choice. Furthermore, I may have missed something, but I am not clear why the division into A and B groups was made, other than to assist in the differentiation/integration process. The advantages in first encouraging separation and then integration was unclear except that disagreement, argument, and adversary positions may clarify issues. When understanding and acceptance are claimed by using first an homogeneous group that focuses on a hypothetical scenario and then an heterogeneous group that brainstorms freely, I wonder if you get what you say you can obtain from the process. It is only in the heterogeneous group that you permit the individual to react to what he truly believes will be the future and even then, he may be biased by having to assume the artificial "scenario" to which he was assigned.

PARTICIPANTS

I am acquainted with only one or perhaps two of the participants. One I know only from what I have read and heard about her in the news media and I am not sure whether the other is the person I knew in Washington, D.C., not Houston. Frances (Sissy) Farenthold is an attorney who has spent the last few years in Texas politics; Thomas Jenkins may or may not be the man who was directing the Federal Power Commission's Natural Gas Survey when I was on leave with the Commission in 1972 and 1973. Appendix A does not furnish any information about the participants other than inductive insights from the facts that they are "Dr.", "Prof.", "Mr.", or "Mrs." and that some of them are identified with companies, universities and agencies. Neither titles nor addresses help to allow a responsive answer to your question. One thing I did observe: except for Ms. Farenthold, I do not believe you had any attorneys participating. I note that one group expressed this view of the law: "The law is only an instrument of social policy, so that many problems which are commonly identified as being legal problems are really problems of lack of national will in any particular direction. (p. 4-63) Perhaps a practicing lawyer would have suggested that we have avoided some of the governmental crisis experienced by other nations because the judicial system accommodates conflicting interests and affords an opportunity for transition without rupture.

I would think for instance that a judge might have made a contribution, and an attorney who has coped with the federal regulatory system, perhaps as a member of government or as a practitioner, might have some valuable



thoughts on the problems facing probable fuels. The attitudes of the Bar are also significant since lawyers are involved in most decisions made by government or industry, and their counseling role in public and private law making can have substantial impact.

#### CONCLUSIONS AND RECOMMENDATIONS

The A groups' conclusions were predictable, it seemed to me---no surprises and no new insights to the problem. B groups' conclusions likewise did not make any additional contributions except that because they were apparently freer they expressed opinions on new subjects. I believe this unanimity is well summarized: "There is considerable commonality in the conclusions of the workshop groups." (p. 5-14) A similar statement could be made about the recommendations, although there seemed to be somewhat more diversity in specifics probably reflecting the expertise of particular participants. There also appears to be some difference in recommendations about the amount of government participation necessary to carry out the recommendations.

I believe that the range of issues addressed was broad and --- probably too broad. From my particular discipline's standpoint, I suppose there was insufficient consideration given to the manner in which recommendations will be implemented. For example, as the report suggests, law is to serve as an instrument of policy, then the capacity of that instrument should have been understood and its limitations appreciated. Since energy regulation has not been successful, the mistakes of the past, distant and near, must be understood in recommending future actions. Without question the manner in

which past policies were enforced or attempted to be enforced has affected our situation today and will affect it in the future.

SPECIAL RESEARCH IN THE NEAR FUTURE

Group B-2 made this recommendation:

"Make a national effort to check the data base for the summary information on oil, gas, nuclear, geothermal and coal resources of the nation. Concentrate on taking the baseline data itself." (p. 6-5)

I believe that one of the most critical elements in meeting the energy problem is public acceptance that there is a problem. Governmental confidence, credibility -- whatever you call it -- must be maintained. As I stated earlier, we basically rely upon industry sources for all energy information; the public therefore is justified in doubting the existence of a crisis when the last one that had immediate impact, the gasoline shortage, seemed to disappear when the price was raised and the independent station operators were forced out of business. There must be a better way to gauge the depth of a shortage than to have lines at the gas pumps, schools closed and workers laid off. If there is all the gasoline a driver can pay for, natural gas available to the highest bidder and company profits at new highs, the public does not see that the situation is anything other than a ripoff, not a true shortage. On the other hand, the doomsayers do not do the job either.

Obviously, then, we need not only the tools to find out what our supply really is but also an agency that has the respect and confidence of the public to use these tools. Deciding which agency is perhaps the greatest difficulty. An initial investigation would consist of simply identifying what information we now have and evaluating the accuracy of its sources. Supply information has been considered the private property of the industry

and, in fact, it has been contended that the government must compensate the industry for the "taking" of the private nature of the information and making it public. Therefore, before the nation's resources are devoted to one course or another, I would like the decision to be made on the basis of facts, facts provided by a disinterested investigation. Although some efforts have been made by agencies, these have been tainted by industry participation and, as I say, in these disillusioned times nothing that is done must have even a hint of improper influence.

#### Baseline Data of Supply

- What are the present sources of energy information?
- How reliable have they proven in the past?
- What techniques have been utilized in the past?
- Which techniques have been the most effective?
- What new techniques do we need?

The one agency I am familiar with, the Federal Power Commission, has been engaged in this effort to supply reliable data for several years. Although it concentrates on the natural gas industry, it also gathers information from power companies about their supplies and sources of fuel. Certainly there are people in that agency who understand the effectiveness of their techniques and procedures, which should be studied and judged to determine their effectiveness in other energy areas.

Of course, no information will be very helpful until we know something about the extent to which existing energy supplies are committed. Here again, obtaining the information will be considered an invasion of business

privacy; however, privacy seems a privilege that should yield to the public's interest in an accurate assessment of our nation's condition. Supply and contracts need to be matched so that we can assess how well private allocation through the market place is functioning to insure the best use of national energy resources.

Consequently, the research I would like done is in the area of gathering and verifying the statistics behind estimates used in discussion of the crisis. Making this information known to the public in such a way that it is credible will help us agree upon a national will to be carried out by law.

Obviously, many things go into "supply" and each should be analyzed. For example, a study of portable fuels would need to show crude supply, refining capacity, and deliverability. Furthermore, since refining capacity, for example, would be dependent upon the need to supplement users of natural gas, any study will extend on and on in our inter-related energy system.

#### Regulatory Structure

A second aspect of the nation's portable energy problem that I believe deserves special research in the near future is deciding what, assuming that voluntary restraints on consumption and price are not sufficient, the best method of regulating the allocation and the price of fuels will be. I have not been involved in the most recent efforts along this line, but I feel sure that a number of lessons have been learned and that the experience would be disseminated and utilized in future efforts. How will the portable fuel distribution be affected by the form of regulation adopted?

What is the best form for the best distribution? Since the organization of the executive branch of government continues to undergo change in the energy area, it would seem that those concerned with portable fuels would want to know whether one form of organization and regulation is more suitable than another, just as one method in behavioral science may achieve more than another.

REFERENCES RELEVANT TO THE PORTABLE ENERGY PROBLEM

In reviewing the bibliography I did not find any Federal Power Commission publications. I have stated that they have published several staff reports and surveys that deal not only with natural gas and power, but also with other fuels, so I would suggest you investigate them if you have not already. In the area of regulation, there are a number of law review articles which can be found in the index to legal periodicals, since regulation of natural gas has attracted the attention of a number of legal scholars recently.

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ATTACHMENT 6

REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

George W. Hoffman  
Professor of Geography



November 6, 1974

6-1

TO: John Vanston

FROM: George W. Hoffman, Professor of Geography

SUBJECT: Review of Portable Energy Technology Assessment Workshop  
Proceedings Report.

Pursuant to your invitation I have the pleasure to enclose my review of the NASA/TRW/U.TEX Proceeding Report on PORTABLE ENERGY TECHNOLOGY ASSESSMENT WORKSHOP, held in Monterey, California, August 25-30, 1974.

Before commenting in detail on the seven (7) specific questions you detailed and the additional general comments you requested, I would like to raise some questions which have a direct bearing on my specific comments.

I. GENERAL INTRODUCTORY COMMENTS

While my review obviously must be based on the proceedings at hand, a number of questions must be raised in these introductory remarks which influence the review and the answers to the specific questions raised. These questions all relate to the initial directions and priorities established. Not knowing enough about the history/background of this project, the answers to some questions, obviously, will be influenced by this lack of background information. Let me briefly elaborate on this basic point.

The first impression when reading the Proceedings is the large number of scenarios posed in such a short workshop period. As a result the discussions and analysis of the various solutions presented is insufficient and if mentioned at all, usually much too general.

A number of participants in their critical reviews (D-1 to D-19) commented on the scope of material presented to the workshop participants and the insufficient time available to digest such material before the beginning of the discussions. Two or three comments referred to the unnecessary amount and

the absence of more selected material which was more directly related to the workshop discussions. It is obvious that I am unable to comment on these points inasmuch as the only references to the pre-workshop material are made on pages 3-15 and in Appendix C and these comments are insufficient for the reviewer's evaluation.

It is therefore suggested, that in the future all material made available to the participants detailing all the pre-workshop preparations, (section 3, does not really provide this pre-workshop background material) should also go to the reviewers. In view of this it is quite possible that a number of my remarks may not have the needed reality and in-depth evaluation, due to the absence of certain key pre-workshop handouts.

In reading the proceedings it is not clear to me if position papers with alternate scenarios were prepared and mailed out in advance, and if such was the case, to what extent these papers were used in the individual workshop deliberations. I personally feel that the statements made by some in section D and on pages 3-15 concerning the pre-meeting input in the workshops can also be viewed from a different perspective. Based on my experience as chairman and member of several national committees, agreement to participate in a workshop (or committee meeting) carries with it the obligation of the participants to prepare themselves for the meeting. (Obviously, most of the participants in this workshop for one reason or another did not work through the preparatory material.)

Another introductory point deals with the selection of the participants and this obviously is closely related to the final workshop product. Details will be discussed under the posed question 4, but suffice to say here that based on the review of the proceedings the impression is obvious that there existed a gap between desired and actual participants. Numerous comments (section D) referred to the insufficient number of "social scientist and

practicing politician" participants. As a result, in the reviewer's opinion, a number of recommendations lacked reality, and certain important alternatives were omitted. The report mentioned on a number of occasions the absence of political scientists, minority representation and younger people, and may I add generally people with radically opposed ideas to the prevailing political climate (and institutional organizations).

## II. COMMENTS ON QUESTIONS 1-7

The basic question to me is actually posed in question #3, the philosophical basis of the workshop approach and the methods used to carry out these principles, and it is for this reason that I will comment on this point first. Re-question 3: the basic philosophy as enunciated in the first paragraph, p. 3-1 was well stated, though personally, I would have preferred not only a consensus, but if need be also alternative solutions with strong arguments presented for each side. Obviously, not every solution has alternatives, but those points with alternatives should have been detailed.

The second paragraph on page 3-1 is clear and to the point, though again I feel that the stress on consensus may have indirectly been the reason for omitting some vital points. My criticism here is that certain key points just don't lend themselves to "organic problem solving." Only by presenting alternative solutions (or if circumstances demand only one alternative) can certain problems be solved. It is obvious that a consensus is the most desirable result, but I would not shy away from alternatives, because by overstressing consensus it is easy to lose sight of initial points made by individuals which are then lost in the discussions by the emphasis on consensus.

The philosophical discussions in this part are clear, to this point and obviously attainable within the framework outlined. Page 3-2 stresses "the right set of participants" and obviously this is an essential part for the success. I will express myself under question 4 on this point.

Regarding the method used to carry out the principles, I somehow have the feeling - influenced by some of the comments under D - that too much was expected in relation to the time available and that the preparatory material had something to do with this.

It was obvious from reading the proceedings that the participants expressed themselves freely and that the philosophical basis of the workshop greatly contributed to the easy flow of discussions and the establishment of mutual respect for the different points of view stated. My only critical comment here is the absence of basically new ideas.

Re-Question 1: The workshop objectives were certainly valid, relevant and applicable, though I am not convinced that all the specific objectives in view of the short time available are really feasible. The latter point was much commented on by numerous participants under section D. The reviewer was especially impressed with the statement (3) on page D-17 "used single scenario for A groups - but let homogenous groupings concentrate in their area of interest - so when they move into B group they have a common base of data and scenario."

Negative comments relate to specific information obtained in a number of workshops (this perhaps can be related to the preparatory material distributed) and the absence of recommendations for near-term actions to be taken now. A number of comments (section D) stressed the absence of well-structured preparatory material, which affected the final product. I commented earlier on the pre-workshop staff work and the actual material presented and the absence of detailed information for the reviewer.

I wish especially to comment on the answers by the participants to question 8 (D-2) "did the scenarios help or hinder the progress of the workshop." Inasmuch as only 11 answers out of 26 clearly stated "help," I am a bit at a loss to

understand these answers. Certainly critic question 8 is closely related to "how valid were the workshop objectives?" To my mind the scenarios were clear, but it would be of interest to analyze these answers as to the background of the individual answering this particular question, though with a preponderance of participants coming from the technical fields, the conclusion could be easily derived that the scenarios were more easily understood by the non-technical participants in the workshop.

Re-question 2: If we study the answers to critic question three, the objectives laid out for the workshops were met, though not with any outstanding success. The reviewer must concur with these conclusions. In his view the reasons are related to the selection of the participants, and the number and perhaps the broadness of scenarios discussed.

Perhaps I should also briefly comment here about the relationship between the stated title of the workshop and the majority of discussions as cited in the proceedings. I am under the impression that the discussions went far beyond the workshop title, but again this may be closely related to the fact that I did not see all the pre-workshop input. At times the discussions are difficult to follow when relating the material in Appendix C (Preworkshop examples of potential actions) and Appendix B (Scenarios) and the actual group discussions under 4 (Workshop Group Reports). Probably the greatest single accomplishment of the workshop was the bringing together of a diverse group of people and their agreement, at least in principle, on a stated "consensus."

Re-question 4: As stated on pages 3-5/6 in the Proceedings, at least on paper the selection process of the participants in the workshop should have served ideally the objectives established. Paragraph 3, pages 3-6 in its first part draws the right conclusion, though I cannot agree with the second part of

this paragraph "an adequate selection was accomplished."\* As a matter of fact, in this reviewer's opinion, this inadequate selection of the participants was perhaps the greatest failure of this project. It is shown clearly in the absence of new ideas (and I refer here to those from the technical personnel and the social scientists), in the conservatism of the ideas expressed and often in the missing correlation with political reality by the absence of working politicians, Mrs. Farenthold notwithstanding (after all she is not in power) and I am particularly disappointed at the absence of opposing social and political institutional points of view (people with these ideas would have to be specifically selected to bring different points of view together). Perhaps the neglect in looking for such people can be explained by the introductory statement on page 3-1 seeking "a consensus," and my somewhat broader understanding of the purposes of this type of workshop to bring out possible alternative solutions.

Closely related to the absence of certain professional representatives was any meaningful discussion of the whole problem of a "flexible urban transportation (mass transportation) policy related to the alternative use of portable energy (participation by city planners, city politicians, urban transport specialists).

Being particularly interested in the international aspects of energy, I miss meaningful references to international cooperation (a general reference on page 5-4 is the only reference I can find), the impact of international developments (non OPEC countries), etc. This absence is to my mind related to the absence of participants knowledgeable in non-US energy developments and specifically its political and social relationships.

A minor point, this one-sidedness in the participants is also indicated by the selected reading list which has few readings in the social sciences and

\*this statement is also contradictory to other statements in the Report.

especially those indicating the social impact of certain portable energy decisions (see page 9 for suggestions).

Re-question 5: I find it simply impossible to evaluate the numerous recommendations and conclusions as presented in the various workshop reports. There is much duplication and a good detailed summary would have been helpful--certainly more than pages 5-13/14. Most of the recommendations are much too general and no priority listing has been established. I miss rather specific recommendations for a course of action.

I must also express my surprise that hardly any reference was made to the social implications of the whole problem of portable energy and its future. Obviously, as indicated in one of the statements published on D-15, some of these questions were discussed in the workshop, but I fail to see many references in the recommendations of the working groups.

Re-question 6: From reading the proceedings including the topics discussed I find the following aspects of the portable energy problems received only very brief mention or were totally absent as indicated in the various recommendations listed: (listing not in priority ranking)

- i. Social costs in various scenarios and at different time periods as a result of technological changes.
- ii. International cooperation in solving some of our problems and many of those can only be attacked and/or solved by such an international cooperation in research, cooperative experimental ventures, political decisions, etc.
- iii. Flexible means of transport (if need be non-competitive) for the purpose of reducing portable energy requirements (A number of European countries for example have already moved from the research stage to the experimental

stage in alternate means of long and short distance transportation).

NO mention of this important development was made in the workshops as indicated by the printed proceedings.

- iv. Conservation was often mentioned as essential to the future availability of portable energy, but details for the most part are lacking. Here an alternative recommendation would have been particularly helpful, together with a priority listing. I would think that both technical experts, social scientists and political leaders could most easily agree. May I also add that I do not simply mean "conservation of energy per se"; I am considering the broad picture of the various uses of energy in heating, transport, etc. and their impact on society.
- v. Institutional adjustments needed in the established U.S. private and public organization due to shortages and increasing demands (even on a reduced level); the question of the relationship between price and profit (most acute and with international repercussions in the oil industry especially); increased government participation in both research and production efforts (was briefly mentioned in the report, but no details were mentioned). It is my opinion that these aspects influenced by our future portable energy development may very well result in the largest disagreements, but perhaps at the same time may offer the biggest opportunity to modernize our institutions in the light of the serious energy picture. Closely related is the whole discussion complex of possible innovations in our institutional set-up which is in dire need of an objective and frank discussion.
- vi. Technological advances must be scrutinized for their possible impact on climatological changes and on the whole range of the human habitat.



Re-question 7: Several of the topics listed above related to the nation's portable energy problems deserve special research for two reasons: (1) insufficient research, or hardly any at all thus far, and (2) research available is insufficiently related to the nation's energy problems. I would put into group (1) items i. and iv. from above, with the rest going into group (2). The research available here is of varied quality and quantity, especially in its relation to the problems posed by this workshop, but also to the broader social and political problems, including alternate solutions.

In conclusion, and in answer to your last broad questions, this reviewer wishes to emphasize the value of the type of studies undertaken and published by the workshop proceedings. Only by experimenting with this type of study will our nation find ultimately a correct and politically feasible answer to its energy problems. My own feeling would be as a next step, another workshop, more specialized, controversially structured, a better distribution in terms of representation of different specialties among the participants. The material derived from such a follow-up workshop together with the first workshop should be submitted to a small study group--who should meet as a "think tank" over an extended, less rushed period and in order to develop certain alternate scenarios. I see no reason for a consensus because the ultimate decisions will depend on political factors and the problems of a given period in the life of a nation.

With respect to specific and relevant references, may I point to the valuable writings by M.A. Adelman, James E. Akins (several articles in Foreign Affairs), Walter J. Levy and other specialists in the international oil field. I am also enclosing a list of readings based on the recommenda-

tions from the various participating faculty members for the forthcoming new inter-disciplinary course Energy and Society.

RECOMMENDED RESEARCH PROJECT

All those listed under question 6 (pages 7-8) are in obvious need of study. I, myself, am particularly interested in the various aspects of international cooperation and its possible impact on US energy developments. The hard facts here are that a number of international conferences were held recently, EEC, OECD, Brookings, Council on Foreign Relations, CMEA, ECE, but no effort is being made, to the best of my knowledge, to correlate and coordinate the findings of these various organizations with the view toward ascertaining their specific impact on US technological, social and political developments--present and future. I am impressed here that private organizations, semi-governmental bodies and international organizations generally when discussing the technical (apart from broad political feasibilities) problems usually find a consensus much easier than the meetings of official governmental bodies (see the Washington meeting of the EEC countries and Japan and the meeting of the EEC).

What I am briefly and very generally recommending is not another international conference, either fact gathering or policy setting (the latter is simply a fruitless effort), but at this stage a thorough analysis by a broadly conceived team of energy specialists from the USA, well versed in the various technical, social and political aspects of the international as well as domestic energy situation, studying the various reports available, and in one document drawing conclusions applicable to this country, including consideration of our world-wide commitments and relations.

Obviously, such a project would require an inter-disciplinary team of about 10-15 people from various parts of the country, together with a coordinator and supporting research and secretarial staff. First it would need to do

preparatory, empirical research of material available and in a workshop extending perhaps for six weeks, drawing the necessary conclusions, based on very specific working paper objectives. Individual members of such a team may have to travel abroad for short periods for the purpose of interviewing and collecting data for the document. The period needed would run twelve to eighteen months. A rough estimate of costs would be in the neighborhood of \$3-400,000. The high costs in part are derived from providing research time for senior specialists and the employment of graduate students, some with a thorough knowledge of foreign languages. The project director would presumably need half time off during the whole period and full time over the summer.

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ATTACHMENT 7.

Evaluation of  
PORTABLE ENERGY TECHNOLOGY  
ASSESSMENT WORKSHOP

by

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November 14, 1974

The basic objectives of the workshop were to define the critical issues associated with various energy policy options, identify the uncertainties associated with them, and make recommendations for government policies toward energy in the future. This is certainly a worthwhile set of goals, which can be attained with various degrees of quantitative accuracy and analytical sophistication. My feeling is that, in general, the workshop did not advance the attainment of these goals, but merely restated the material (scenarios and potential actions) used as background, and presented a menu of policy options well known beforehand with no further original indication of relative or absolute urgency. Two exceptions to this general outcome are illuminating discussions of tactical issues: optimal R & D strategy in terms of number and scale of projects, and the difficulty of implementing rational policies through a bureaucratized government hierarchy (A-6). In the remainder of this report, I will further discuss the presentation of critical issues and policy recommendations of the workshop, and how I feel a more productive consideration of these matters could be made. In the course of this, some specific problems in the conclusions and recommendations from an economic point of view will be discussed.

### Critical Issues

There is certainly value in examining past trends of energy consumption and other relevant variables, extrapolating these in some reasonable way (such as through the scenario method) into the future, and confronting the resulting demand figures with



assessments of likely future supply. This is an important first step in getting information above potential trouble spots, and has been used by forecasting groups assembled by the NPC and OCCD to reach such broad conclusions as the necessity of rapid growth of nuclear electricity generating plants. In its considerations of the future, the workshop did not go beyond this sort of exercise, using various sets of supply availability data, (eg. groups A-2, B-4, B-5), so nothing new was added to our knowledge about the future.

In my opinion, the necessary next step in such forecasting work (which is what "issue identification" is) is to integrate the consumption and availability forecasts through the nexus of price, so that an internally consistent set of projections can be found, in which the demand for and supply of any energy source both depend on the price of that source, and markets act so as to bring supply and demand into equality. The assumptions implicitly made in the workshop reports are that supply and demand are perfectly inelastic, or that the price level has no effect on consumption or production. However, the basic purpose of markets is to bring quantities demanded and supplied into balance, and a more useful set of projections would take this point into account. Therefore, one might usefully prepare a base forecast in which markets are given free reign, producers and consumers are allowed to respond to price with no constraints, and the resulting equilibrium of prices, and quantities consumed, produced and imported is determined.

With a forecast of this sort, some of the issues raised in

the workshop could be addressed more coherently. For example, there was concern over the large capital requirements needed for expansion of production. But in a market system, higher requirements are translated into higher prices, with the resulting dampening effect on demand. Users of energy sources would only purchase the energy at higher prices if its utility to them was correspondingly higher, and therefore if the capital burden is very large, low priority uses of energy will be cut off and the capital simply won't be raised. If there was unhappiness on the part of decision makers with the market outcome, due to say dangerously high import dependence, this consideration could then lead to policy recommendations. But the framework for evaluating the fixture energy situation would at least capture the elementary idea that energy is not demanded unless its cost is below that of the next best substitute.

This expanded framework would allow the twin recommendations of conservation and expanded domestic production to be viewed more accurately. If conservation does not voluntarily occur in the market, consumers are signalling that at current prices energy is still cheap relative to the cost of doing without. What justification is there for imposed conservation measures? Potential answers are false consumer information, delayed perception of cost charges, or social costs of energy use above private costs. Similar considerations apply to proposals that the government provide capital for expanded production when the price is not high enough to induce private investment. This can be justified on the grounds of producer price uncertainty,

extreme economies of scale, or a situation where private costs exceed social costs. The point here is that in a market view of the energy future, some explicit justification must be made for any recommendations which supersede the normal workings of the market. In particular, such economically vacuous goals as attaining "adequate supplies of acceptable forms of portable energy" (2-2) can be put aside, and the time issues, such as how much of which sources of energy are available at what price, can be investigated. The view of the data presented in the workshop report simply does not address this goal.

#### Policy Recommendations

This list of potential policy actions prepared for workshop participants (Appendix C) is a complex well-documented list of the options facing the U.S. government. The list of policy recommendations made by the workshop (Section 6) is essentially a relisting, with the policies regrouped somewhat by time horizon. The theme of the workshop report seems to be, "These are all promising avenues of approach," which is certainly true. Therefore, I don't feel any particular progress was made here in delineating optimal government policies. One reason might have been the simple nature of the quantitative framework within which participants were working, as discussed above.

One particular area in which economists have an interest in policy recommendations is in identifying trade-offs, i.e., in pointing out that any policy that attains some worthwhile goal will often entail an offsetting cost, and that policies

should therefore be adjusted until costs are just offset by benefits. Participants in the workshop had varying degrees of sensitivity to this issue. For example, workshops A-2 and B-6 explicitly considered that conservation efforts and protective tariffs, respectively, imposed potentially high costs on the economy as a whole, and that these costs had to be considered by decision makers. However, B-6 then advocated a "no-waste ethic," with absolutely no realization that this imposes costs just as surely as other measures. When energy use is cut down, substitutes must be found, and it is the cost of these substitutes (more maintenance personnel, more insulation, more travel time, more cramps in legs on arrival) that must be weighed against energy costs. At any rate, I would recommend more consideration of these kinds of issues in further research on energy policy options.

In conclusion, I do not feel that any advances in understanding of future energy issues or the relative priorities that should be accorded government policies was forthcoming from the workshop. However, the report does mention one outcome that may be very significant (3-4-3-5): the participants agreed that their understanding of energy issues, especially those on which there were sharp differences, had been enhanced, and they could better understand the bases of different viewpoints. This educational value of the workshop could be very important. I am unable to judge the qualifications of the participants but they seem to be in responsible positions, and a general airing of differences of opinion could be quite valuable in clarifying important future issues for them.

ATTACHMENT 8.

Review of NASA/TRW/U. Tex

Portable Energy Assessment Workshop PROCEEDINGS REPORT

Monterey, Calif., August 25-30, 1974

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Submitted to CENTER FOR ENERGY STUDIES  
THE UNIVERSITY OF TEXAS AT AUSTIN

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## Objectives

Evidently the NASA/TRW/U. Tex Portable Energy Technology Assessment Workshop achieved some useful and even striking results. Relatively few of these results, however, appear to represent fulfilled objectives.

The first of the two major objectives, to "tap . . . a comprehensive sample of information, attitudes, and opinion related to portable energy problems,"<sup>1</sup> was less ambitious and more realistic than the second major goal. The constraints imposed by time and the techniques adopted for the workshop set rather severe limits on the quantity and richness of the information exchanged. Though relatively small and unstructured, the sample of information evidently was large enough and rich enough to inform and sustain the production and exchange of "attitudes and opinions." Because the structure and management of the workshop biased the output in favor of the oral and the subjective, the circumstances of the week of August 25-30 apparently were successful in eliciting rather exhaustive exchanges and analyses of attitudes and opinions. Although the work--and the printed evidence of the work--of some of the groups may have been heavily or unduly dominated by the chairpersons or by one or a few group members, the Proceedings Report is silent on this aspect of the workshop.

The second major objective of the workshop comprised an effort to achieve some agreement on fundamental issues and recommendations, together with "a clear identification of valid differences."<sup>2</sup> Despite the comments to the contrary in the Proceedings Report,<sup>3</sup> relatively little agreement on fundamental issues is evident in the Workshop Group Reports.

Some of the agreement apparent to the authors of the Proceedings Report--on the slowing of the growth rate of energy consumption, for example--is not so much agreement as resignation. Several participants and groups apparently believed that the most plausible mix of future circumstances would depress the rate of growth of energy consumption. Not all of these individuals and groups, however, appeared to believe that a flatter growth curve would necessarily be desirable.

Relatively few issues, in any strict sense, are identified with unanimity in the Workshop Group Reports.<sup>4</sup> Many of the groups carried out remarkable analyses and produced concise, realistic statements about their assigned scenarios. Although the quality of the A-Group analyses especially ranges between excellent and uninspired, the same sense of inhibition is apparent in each instance. This inhibition was imposed, apparently, by the necessity for each group to address itself to a fixed future. The same necessity may have prevented most of the groups, and the workshop generally, from addressing more specifically portable energy problems.

The "clear identification of valid differences" called for in the objectives of the workshop<sup>5</sup> apparently consists of the rather self-consciously appended minority statements that appear in some of the reports. Most of these minority positions turned on such highly-charged emotional issues as nuclear reactor safety and radioactive waste disposal. Apparently none of the groups could frame statements of alternative approaches among their members to such issues as the allocation of social resources or the efficacy of existing economic and political institutions.

## Methods

The methods employed to pursue the objectives of the workshop yielded striking and valuable statements of several clearly stated attitudes and opinions (see page 2 above). A change or two in the adopted approach might have yielded equally striking output and perhaps less inhibited material. The necessity for each group to react to a complete scenario, including fixed levels of energy consumption for 1985 and 1995, might have been relaxed for one set of workshop groups, possibly to encourage these groups to work out their own most plausible mixes of energy sources and levels of consumption. The alternative groups, working with less specifically quantified scenarios, might also have been encouraged to spend more time on portable energy technology specifically.

Another possible variation on the method adopted might have allowed one group to flesh out complete alternative-future scenarios while the other group, or set of groups, worked with portable energy technology futures exclusively. In a final general session, the second group might have bounced its ideas for portable energy technology futures off the constraints iterated by the full-scenario groups, those working with complete energy economies.

## Conception and Participants

From one point of view, the problem of the fundamental conception of the workshop is bound up with that of selecting the participants. Any assessment of the objectives, the fundamental conception, and many other aspects of the workshop is rendered a little more difficult--and a little more irrelevant, perhaps--than necessary by the absence from the printed documents of the list of the roughly one hundred persons



actually invited to the workshop. This list could be assessed on the basis of the original conception and speculation about what this conception, if realized, might have yielded. The projected list of participants may, however, suffer from the same imbalance as the list of the actual thirty-eight participants.<sup>7</sup> The Proceedings Report itself comments on this imbalance, but the outline presented of potential participants itself exhibits a considerable lack of balance.<sup>8</sup>

Excluding those two participants whose expertise cannot be certainly identified, here is an outline classification of the participants, according to a scheme which is not hopelessly arbitrary:

Government	9
University	11
technical	( 6)
non-technical	( 5)
Business, industry, professions	15
technical	(11)
non-technical	( 4)
Labor	1
Consumer and environmental interests, lay persons	0
Total	36

Of the governmental representatives, all were from the federal level, and all were appointed officials. Most of these were technical persons. The original intention, according to the Proceedings Report,<sup>9</sup> contemplated representatives from every major executive agency of the federal government and from the Congress. Evidently representation from state and local government was not sought. All eleven academic representatives were from the university level, and all were faculty members. These representatives, however, struck a balance between

technical and non-technical fields. Eleven of the fifteen participants from business, industry, and the professions were technical persons; at least two of the non-technical representatives were practicing attorneys. The single representative of organized labor held an administrative/research position. At least twenty-two of the thirty-six participants whose expertise was identifiable were technical persons.<sup>10</sup>

According to the Proceedings Report, the projected list of participants included elected government officials, representatives of environmental and consumer groups, and the news media.<sup>11</sup> The authors of the Proceedings Report also advanced the opinion that "members of the 'younger generation'--for example, college students" might have been included as participants.<sup>12</sup>

Both the criteria for the selection of the participants and the participants themselves could be said to reflect an elitist bias on the part of those who designed the workshop.<sup>13</sup> The designers were seeking "leaders" who were "articulate . . . intelligent . . . concerned . . . and interested enough to spend a week working on the problem."<sup>14</sup> Clearly such persons also had to be able to get away from their jobs for a week.

Much of the relevance of the conception and the objectives of the workshop would appear to depend on:

1. the extent to which the participants (or intended participants) constitute a representative sample of future decision-making potential and of potential future influence in terms of public policy formulation and implementation;

2. the extent to which present institutions and technology--or quite similar institutions and technology--will operate in the

future; and

3. the extent to which any useful ideas generated in the workshop can be disseminated at least into the literature which may be drawn upon by those contributing to the making and executing of future public policy.

The participants (and probably the projected participants) include almost all traditional technologic and decision-making potential except for elected public officials. The group is too selectively defined, however, to represent more than a narrow spectrum of public opinion. The occupational groups represented by individuals such as the participants--professional and technical workers and managers and administrators--made up only 23.8 percent of the employment in the United States during 1972. By 1985, these workers are expected to amount to 27.1 percent of all employment. Although the group is growing rapidly and will account for more than 40 percent of the 1972-1985 employment growth, these occupations still represent a minority.<sup>15</sup>

Nor is the "'younger generation'--for example, college students," representative of more than a minority. The younger generation is a representative group, but college students are elite. Students aged 18-21 and enrolled in college during October 1973 accounted for only 31.1 percent of the 18-21 population. More than 90 percent of these students were white. One in three white persons aged 18-21 were college students in October 1973, but less than one in five black persons in this age group were enrolled in college.<sup>16</sup>

As to "youth" generally, 17.5 million of the persons aged 18-24 in 1972--71 percent of the total--were not enrolled in school.<sup>17</sup> Persons

in this age group enrolled in school represent a definite minority.

Much of the circularity (an elite inviting an elite to sit down and talk) which informed the selection of participants also imposed a bias, or at least a crippling inhibition, on the technologic assessment carried on by the group. Although the scenarios were well conceived and plausibly constructed, the scenario scheme itself (see pages 4-5 above) appears to have contributed to the tendency of the participants to think almost exclusively in terms of extrapolations of present technology. Similarly, the participants scarcely noted the possibility of radically altered or wholly new economic, political, and social institutions in the future.

The probability is high that any significant output from the workshop will be incorporated at least in one or more of the specialist literatures and will therefore be available in the future. The Proceedings Report pointed out that the workshop, in both composition and management, gained little effective access to popular media.<sup>18</sup>

#### Conclusions and Recommendations

General comments on the conclusions and recommendations have already appeared in this review. The conclusions of Groups A-2, A-4, B-2, and B-4 rounded out particularly sound and realistic analyses, although the B-4 analysis might have been less mechanical. The only significant policy emphasis appears in the reports of Groups B-3 and, to a lesser extent, A-2. No group concentrated on issues and policies.

Most of the recommendations appear much weaker than the analyses themselves and the conclusions. The participants individually and the groups collectively apparently shared considerable diffidence and lack of confidence at the point of actually advancing recommendations. Conceivably this difficulty was related to the general failure of the

participants to come to grips with specific issues, as opposed to quantities and technical mechanisms. At least in comparison with those of other groups, the recommendations of Groups A-1 and A-4 appear insufficient or inadequate. The recommendations of Groups A-2, A-5, and A-6 are generally unrealistic. Although too many goals are listed, the recommendations of Group A-3 include several practical, hard-headed objectives.

#### Unanswered Questions

Aside from devoting too little time to portable energy technology, specifically and narrowly, the workshop failed most notably in the sphere of addressing crucial issues. The groups demonstrated little concern with or interest in crucial policy questions, although several comments appear to recognize the central role of politics in the future of energy management. Most of the assumptions, or apparent assumptions, of the participants appear to rest on virtual extrapolations of present technologies and institutions. The participants might profitably have addressed these questions:

1. How can the present mix of energy technologies make the transition to one or more of a set of alternative future mixes, and what are the plausible configurations of these future mixes of energy technologies; and
2. How can present institutions (economic, social, political) be modified, or be allowed to be modified or replaced, to implement plausible alternative energy futures with a minimum of social disruption?

#### Research Needs

One of the most urgent needs, in portable energy technology and alternative future energy technologies generally, is for policy-oriented research based on plausible alternative futures in energy and institutional

mixes. Relationships such as that between national energy consumption (defined in various ways) and gross national product have changed more than once in the past. These and similar measures and relationships have not been adequately studied in terms of the plausible range of their modification. This relationship and others have been used as some of the bases of predictive tools, even though their past behavior has not been fully studied or fully understood.

The economic history of the United States offers several examples of rapid and deliberate institutional change to achieve goals, such as the rapid and effective mobilization of social capital, that could not be accomplished within the limitations of existing institutions. Similar changes have occurred which were not deliberate. None of these mechanisms and transitions have been adequately studied from the point of view of present energy problems.

#### Notes

1. NASA/TRW/U. Tex, Portable Energy Technology Assessment Workshop: Proceedings Report (Monterey, California: NASA/TRW/U. Tex, August 25-30, 1974), p. 3-1.
2. Ibid.
3. Ibid., pp. 5-13 - 5-15
4. Ibid., Section 4.
5. Ibid., p. 3-1.
6. Ibid., p. 3-6.
7. Ibid., pp. A-1 - A-3.
8. Ibid., pp. 3-5 - 3-6.
9. Ibid., p. 3-5.

Notes (continued)

10. Ibid., pp. A-1 - A-3.
11. Ibid., pp. 3-5 - 3-6.
12. Ibid., p. 3-2.
13. Ibid., pp. 3-5 - 3-6, A-1 - A-2.
14. Ibid., P. 3-5.
15. U.S. Department of Labor, Bureau of Labor Statistics, The U.S. Economy in 1985. A Summary of BLS Projections, Bulletin 1809 (Washington, D.C.: Government Printing Office, 1974), p. 19.
16. U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, School Enrollment in the United States: October 1973 (Advance Report), Current Population Reports, Population Characteristics, Series P-20, No. 261 (Washington, D.C.: Government Printing Office, March 1974), pp. 3-6.
17. \_\_\_\_\_. Characteristics of American Youth: 1972, Current Population Reports, Special Studies, Series P-23, No. 44 (Washington, D.C.: Government Printing Office, March 1973), p. 9.
18. NASA/TRW/U Tex, pp. 3-2, 3-12, 3-14.

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ATTACHMENT 9.

PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP

A REVIEW OF THE PROCEEDINGS REPORT

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1. It has already been noted in the Report that the workshop objectives could have been more clearly stated, but I must add more. As stated on page 3-1, the objectives are much too generally defined. Everyone would like to have a broad-based pool of information, opinions, and attitudes from which to define the key issues of a given problem and to give recommendations about what to do. The actual objective of the project is clear enough, however, as stated on page 2-1: NASA needs to know what to do about portable fuel for the future. Following that statement on page 2-1 are various aspects of the problem, some of which are reiterated in different words on 3-1 as items to be covered in accomplishing the workshop "objectives". In short, reiteration, duplication, and confusion of issues loom large. Perhaps the entire picture could have been rendered more exactly in some manner such as this:

A. The portable energy project is a joint effort by NASA/TRW/U. of Texas to help NASA in identifying courses of action, strategies, research and development which will result in adequate supplies of acceptable forms of portable energy for the 1980's and 1990's.

B. As a part of that project, the workshop will address itself to these objectives:

1. What are the critical issues associated with portable energy options?
2. What are the areas of uncertainty and risk associated with these options, and how can we overcome barriers to their implementation?

2. What near-term actions should be taken now?

Thus stated there is a specific problem to be addressed, and some questions to be answered by the workshop participants. When all is said and done, the problem may be one of how things are stated and arranged, but simple as such considerations may seem they can be crucial to the success of a project.

Since I don't like the objectives as they are stated on page 3-1, it is difficult for me to review the report in light of them. Thus I am going to take the liberty of using the three items above as "objectives" and to continue my review on that basis. One large question remains in mind, however, as to the difference between items 1 and 2; nowhere could I find spelled out what is meant by "critical issues" or by "areas of uncertainty and risk".

The scheme of things as I have "rehashed" it here would seem feasible, relevant, applicable, and so on, but I prefer to answer such questions, and the second item concerning how well the objectives were met, under point 5 below.

3. I am not sure what, precisely, the philosophical basis of the workshop was, but I gather that, roughly, it was the idea that human "simulation" is useful in problem-solving. In putting that idea into practice some "techniques" designed to facilitate small-group interaction were employed, an attempt was made to balance tension with "comfort" (in this respect note that item b., page 3.3, designated as a way of promoting tension seems to be the same as the item in the following paragraph which is given as a way to counter tension), and that a dialectical situation was encouraged (conflict generated by extremes is reconciled into agreement--in old words, a compromise). In general I have no argument with the idea of simulation, but I would encourage looking into the areas of social psychology, small group research, game theory, decisional analysis, and so forth for future workshop preparation.

One specific question I do have concerns putting the homogeneous groups before the heterogeneous groups. For one thing, I disagree that the homogeneous group would necessarily strengthen similar views among members. Having taken Appendix A and filled in Table I with a designation of the participants' backgrounds (excluding 3 individuals for whom no affiliation was indicated), I would not agree that the homogeneous groups were homogeneous. Perhaps other criteria and other knowledge were used that I am not aware of, but combining business people, government people

and academicians, as in the case in every "A" group, leads one to suspect the homogeneity of ideas among them. Second, it might be equally to the point to pit opponents in order to intensify opposition, and then watch proponents as they integrate their experiences. I could go on with remarks about this aspect of the report, but let me summarize by saying that the "philosophical idea" and "methods" are useful and appear to have been successful, especially given the fact that this is one of the first such workshops, to my knowledge, actually to have been held. I do doubt, however whether the presence of so many "monitors", "facilitators", and "observers" from the NASA/TRW/UT side helped very much in a situation involving prestigious, respected, and intelligent participants. One "outsider" highly trained in small-group dynamics would have been sufficient, especially given the material resources available, such as recorders.

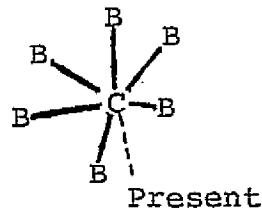


4. (A) As far as I could tell from the list of participants, the social sciences were represented by one anthropologist and two political scientists. No sociologist or psychologists were included. (B) The presence of an architect might have been helpful as well insofar as the construction/insulation of buildings and related items appeared frequently in the workshop group reports. Patterns of transportation and urban development, the siting of homes, industries, and recreational facilities are interdependent. Some imaginative work must be done for planning of future residential-work units. (C) I agree that the political segment of the society should have been included; planning the workshop for a Congressional recess might have helped. In lieu of getting a Congressman to attend, many Congressmen could have sent high ranking members of their staff who could competently have contributed on "political" issues. (D) Including the mass media is a question that I am unsure about, but a marketing or advertising expert might have been useful. (E) I would argue against including "the younger generation". It sounds nice on paper, but we all know that, depending on the choice--a difficult matter in itself--the radical student leaders of today may well be the conservative businessmen of tomorrow. Perhaps inclusion of young professionals would be a better alternative. They stand to gain in future decades the prestige and authority that some of the actual workshop participants now have.

5. Now we come to the crux of the review: the conclusions and recommendations of the work groups. Let me say, first of all, that the scenario approach seems to be a useful one. The use of scenarios in a workshop setting should encourage flexibility in thinking about the future. I have heard that several hours were spent at the start of the "A" work group period in discussing what the scenarios were for. That waste of time could have been avoided, perhaps, had the objectives of the workshop been clearly understood and had the role of the scenario been clearly explained as a "prompting device".

I note on page 3-10 that the participants were sent, prior to the workshop, a set of optional actions and one scenario to examine. Did the participants also receive the centrario and the background information, data, and glossary as these are presented in the mimeographed report? The latter are necessary "baseline" inputs to any reasoned solutions to future situations. Perhaps, too, the participants would have had a better over-all view of the workshop had they read all six scenarios, while knowing that they would be asked to direct their attention to only one. In this manner, the participant knows (a) the present situation, (b) the probable future situation following extrapolation of present trends, and (c) a future situation exaggerated in one or more dimensions. The future, in fact, is not likely to fit the centrario, but

some point in multi-dimensional space around the centrario,  
as sketched graphically below.



The collating, organizing, and arrangement of material is poorly done in the Report. In fact, one could easily get the impression that nothing but very general, almost superficial, suggestions were made by the work groups. As presently organized, the amount of redundant material is discouraging. On close scrutiny, particularly of section 4, I finally came to the conclusion that many substantive, useful suggestions were made at the workshop, but I fear that their value is to be lost in the way the material is being handled. Some outline of general directions and recommendations is useful, certainly, but I would like to see a clearer picture with more specific details. For example, some useful recommendations for near-term actions, it seems to me, might be (a) mandatory use of steel belted radial tires, (b) reduction of average automobile weight, (c) reduction in engine displacement--all of which are listed on page 6-8, but not as near-term actions. Participants at the workshop were qualified to estimate the practical aspects of such actions--how long will it take, what will it cost, how much will it save? The "facilitators" could, it seems

to me, have been useful in "picking the brains" of the participants by asking questions regarding specifics, or details, of such suggestions as they arose. I found some very interesting discussion in section 4 concerning "adverse aspects" of various strategies and "blocking forces" of recommended actions. Had these been brought out more clearly some of the uncertainty expressed by participants as to the social and cultural consequences of energy policies could have been resolved.

In short, my evaluation of the conclusions and recommendations of the workgroups is that (1) as stated in the Report, they appear to be too vague and general to be of much use, but (2) the material for a more useful substantive analysis is there if it can be more carefully gleaned and organized. In reading I have taken a stab at that in my own mind, but I am asked to review the Report, not to do it.

6-7. The aspects of the portable energy problem which I should like to see better addressed, given my particular disciplinary interest in sociology, involve precisely the areas that the workshop participants felt most uncomfortable about: what are the social-cultural consequences of changes in energy consumption? What actions will the public initiate or, at a minimum, accept? What changes in institutional structures are needed and what consequences will such changes have? Information is available to help in answering some of these questions and others, but much of that information must be collected from what will seem, at first, peripheral or even unrelated research areas. Research on political behavior and stratification, for example, includes data on voter apathy and the effects of communication on attitudes and behavior that would be useful in assessing how people will support or accept varying degrees of change. Information on the major institutions in society--policy, economy, education, family, religion, voluntary associations, leisure activities--could be used to construct pictures of our society as it might be restructured along various dimensions. It is telling, and I choose here one quote from many possible ones, that on page 5-13 of the Report, the participants state, "We cannot therefore rationally decide on whether to accept nuclear risk or a restructured society stemming from negative per capita energy consumption." The dilemma plagues citizenry and politicians, too. Knowledge of "black holes" in space is nearly as widespread and deep as knowledge of ourselves and our society.

Given the relative vacuum of sociocultural informational

input into discussions of energy problems, there are multitudinous research proposals that could be suggested and profitably carried out. To begin with, there is an obvious need to integrate the professional skills of social scientists with those of natural scientists in approaching the problems of energy. One action in particular, and it is a demanding one, could be taken to effect such integration. An on-going "monitoring" research group is needed to continually assess, revise, and assess again the complex interrelationships between social and cultural values and technological changes. One way to begin dealing rationally with the ever-present "cultural lag" is to know where we stand.

A team of scientists should be supported who would have access to diverse data bases from census materials to public opinion surveys to social movements analyses to transportation patterns to the most recent technological research on energy generating facilities. The interesting thing is that as ideal as that suggestion may appear, the data is available; it is the integrating framework that is lacking. TIME magazine does a better job of providing dynamic analyses than does our academic community. The major task of the team would not be to gather material, but (with ample computer facilities) to coordinate, analyse, and update a dynamic system analysis using the substantial amounts of information already available from diverse sources and which is continually being collected by one institution or another. Such a team would not be "a crash R&D program" but a permanent research facility with personnel input from

academia, business, and politics for a multi-disciplinary approach. As an information base, the team should be publicly accessible.

Since humans are by nature unsuited for work in a constantly changing situation with a constant input of new material, I would suggest that the team be composed of people on two-year appointments. In this way, personnel would be rotating fast enough to ensure that entrenched approaches or personal ideosyncracies be avoided as much as possible, frustration due to rapid turn-over of information could be minimized, and top people--experts in their fields--could more easily accept such appointments and take leaves of absence from their academic posts or professional positions.

Funding for the team (including permanent facilities) should be assured for at least a minimum period (say, ten years). That funding would probably be jointly contributed by the federal government and by major research institutions with nominal sums contributed by units seeking team information. The team should be completely autonomous and responsible only for the quality and reliability of its output to designated individuals in government and research institutions and perhaps to an appointed review team of "peers" (i.e., other professionals). Details of appointments must be worked out with care to ensure, as much as possible, that political considerations are kept to a minimum. The research team would be a permanent body with permanent facilities from whom invitations to participate are issued to individuals with top credentials in their fields.

Let me now mention some more specific research projects which might be considered.

A. Much has been made of the fact that Americans are overly dependent on their automobiles. Various types of interpretation have been put forth to explain that dependence, from a "back to the womb" feeling when cocooned in the car, to an instrument for women to sublimate their envy of male "force" and "drive." Such eccentric and off-the-cuff interpretations notwithstanding, a serious study is needed regarding the individual's assessment of the importance of being geographically mobile, of his dependence on the private automobile for that mobility, his "threshold" for using mass transit (i.e., what must the cost be to induce him from his automobile), his frustration level in terms of time, crowding, noise, and so forth, which must be seen as boundaries in developing successful mass transit alternatives. Such a study should begin by researching all information now available (and some work has been done on public opposition to mass transportation), studying relevant social psychological material, and going to the field with an interview/questionnaire tool.

This study might take into account, for example, such things as distance and purpose in transportation (see chart below).



RANGE-MILES	DESIGNATION	MODE	
		PASSENGER	FREIGHT
1. 1-10	Very short (local, urban)	Foot, horse, bicycle, scooter, car, bus, subway, escalator	Truck, pipeline, conveyor
2. 10-100	Short (suburban, rural)	Car, bus, rail, boat, escalator	Truck, pipeline, rail
3. 100-1,000	Medium (continental)	Car, bus, rail, boat, airplane, G.E.M., VTOL	Truck, rail, airplane, G.E.M., VTOL
4. 1,000-10,000	Long (inter- continental)	Rail, airplane, ship, G.E.M., ramjet, rocket	Rail, ship, air- craft, G.E.M., submarine

G.E.M.: Ground Effect Machine.  
VTOL: Vertical Takeoff and Landing Aircraft.

Source: Arthur C. Clarke, Profiles of the Future.  
1963 New York: Bantam Books.

An individual, for example, will be more willing to ride a bus or take a moving sidewalk four blocks to a shopping center (if adequate facilities are available for taking packages home) than he will be to ride eight hours on a frequently stopping bus to visit his family in the hinterland.

B. Given the assumption that human beings are animals prone toward ranking each other, what stratification schemes might emerge in our society if decreasing energy consumption creates changes in traditional bases for ranking? Despite the by now cliché sound of it, the truth is that Americans are materialistic and consumption oriented. One of the major criteria for ranking or rating or evaluating each other is

the level of material wealth displayed. With decreasing energy availability, many consumption items will disappear; we may no longer be properly impressed by our neighbor's three television sets, automatically opening garage, electric can opener, shaver, knife, and oven. But if material items decrease in importance as a basis for evaluation of the individual, something else will take its place. Will it once again be race, or ethnicity, or education, or something entirely unforeseen? Man will always have the need to say to himself and others, "I'm better than you are. I have more prestige than you do. But that other guy has even more prestige than I do." Such ranking helps man order his existence. Understanding the bases of a stratification system, in turn, is crucial to an objective understanding of the society and its changes.

C. A study is needed of lines of communication and influence between decision-making elites and the public. When lines of communication break down, consequences are apathy or mass movements or both. Political sociology has much to say about the dynamics involved in information dissemination and opinion formation.

ATTACHMENT 10

REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

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November 11, 1974

REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

In reviewing The Proceedings Report I will proceed by first posing a question and then proceeding to discuss an answer to the question.

1. How valid were the workshop objectives in terms of feasibility, relevance, concept, applicability, etc.?

First, on the question of feasibility, it is relevant to consider whether it is possible to get a good cross-section of the type desired. As mentioned in the report, it is difficult to get people from the political area and the media. In addition, it was pointed out that the "younger generation" was overlooked. At the bottom of page 3-1 it is stated that "we attempted to get a group of workshop participants who would comprise a reasonable cross-section of opinion of the American public." The group assembled, and even the group envisioned, if you include the media, politicians and the younger generation, certainly do not represent a cross-section of the American public. The group which was actually assembled, though, seems to me to be a little top-heavy on people from business and engineering backgrounds. Getting back to the question of feasibility, one must ask how feasible it is to assemble a cross-section of the type hoped for. Obviously,

it is going to be difficult to get some of the people from some of these areas to come.

On the question of relevance, the objectives seem without question to be highly relevant to an important contemporary American public policy issue. On the questions of concept and applicability, the objectives seem fruitful and promising.

2. How well were these workshop objectives met?

The objectives, as stated on page 3-1, were, on their own terms, obviously met, as certainly they achieved the goals of (A) tapping into a comprehensive sample of information, attitudes, and opinions related to portable energy problems and (B) coming up with some agreement as to the key issues and some collectively supported ideas and recommendations on what to do about the situation. Evaluation of the conclusions and recommendations of the work groups will be considered later.

3. Evaluation of the philosophical basis of the workshop approach and the methods used to carry out these principles.

It is unclear to me whether the purpose of the overall project was to provide information to N.A.S.A., to provide an educational experience for the participants, or both. The appropriateness of the basis of the workshop approach would vary depending upon which of the preceding the ultimate goal actually was.

As I have already mentioned I have questions regarding the nature of the group of participants that was planned for. It seems to me that the spectrum was somewhat limited and that, to the extent that it was considered desirable to have a wide spectrum of opinion represented, it would have been advantageous to have included artists, historians, radicals, and representatives from other disaffected groups.

As a considerable outsider to the field of social psychology I found the discussion on pages 3-3 through 3-5 fascinating. The differentiation and integration approach challenged me. It seems to me to be definitely a worthwhile basis on which to attempt to build an experiment of this type. I would think that the most fruitful result of this experiment would be on the minds of those who participated, rather than in the information provided to N.A. S.A. In this regard, the most valuable way in which this experiment could be of service would be to play this game with many of the key people who will actually be making the decisions - the President, the head of the Federal Energy Office, the head of N.A. S.A., the Secretary of the Treasury, etc. How fascinating it would be to bring them into such an experiment and expose them on an intensive basis to the views of a diverse group of intelligent, articulate people.

I think that the idea of putting severe time pressures on people is a good one. From having participated in such an exercise I find it amazing to know what one can do in a short period of time if one has to.

One question I had about the differentiation-integration approach was how much of the strategy discussed on pages 3-3 to 3-5 was revealed to the participants. To what extent were they doing what was expected of them in a game in which they knew or could guess what the desired behavior was?

#### 4. Qualifications and balance of the participants.

I have already discussed the question of balance. It is impossible to assess the question of qualifications from the information given in Appendix A. Those people of whom I know something as a result of name recognition appear to be highly qualified.

#### 5. Evaluation of the conclusions and recommendations of the work groups.

The conclusions of group A-3 were rather thin for such an interesting scenario.

Except for groups A-2 and A-5 the conclusions did not seem to flow from or be particularly related to the scenario.

There seems to be no consensus among the groups on what the conclusions are supposed to be. For example, should they be findings of fact, identification of issues, statements of policy options, recommendations on policy choices, or something else?

Although the stated purpose of the workshop was to focus on portable energy problems, the participants do not seem to have confined themselves in any way to this aspect of the problem.

They range far and wide. As a result any focussing in on the unique and special problem of portable energy was lost by the fragmentation and scatteration of the effort.

I will now discuss the conclusion in terms of relevance, quality, consistence and heuristic nature.

The workshop report and the conclusion of group A-3 seem to be unrelated to or in conflict with the scenario. A major part of the scenario was an expansion of programs to produce equality of educational and economic opportunity. The conclusions of group A-3 appear to be unrelated to the scenario. As indicated above, their conclusions are rather thin for such an interesting scenario. In addition, the final report of workshop group A-3 contains items which are in conflict with the scenario. As an example, agreed action item 1-B - "amend environmental protection laws to allow more time for full implementation of clean air standards" - would be in conflict with the equal opportunity scenario, as it would affect the distribution of income in favor of upper income groups. Action item 1-D calls for an energy research and development agency to be a major participant in cost sharing to develop means for insuring that new technology goes from research to commercial status. This proposal would also affect the income distribution in favor of upper income groups. Looking at the scenario, the report and the make-up of group A-3 one infers that the scenario was not in tune with the social outlook of the members of that group, who come mainly from business and from agencies in government which seem to be technical or engineering in background. The above comments refer



also to the conclusions of group B-3, whose conclusions consist of a reference to the conclusions of groups A-3.

With the exception of the reports of groups A-3 and B-3, all of the other groups' conclusions rate high marks on the criteria of relevance, quality, consistency, and heuristic quality.

I shall now consider the recommendations of the workshop.

In many, perhaps most respects, the recommendations also rank high according to the criteria used above. However there are some particular items and areas covered by the recommendations with which I would take issue. The introduction to the summary of workshop recommendations states that "one characteristic was prevalent throughout the recommendations of the workshop groups, and this can best be described as a concern for the total system...the total system is not just limited to hardware or plant configurations but is better described as including the social, political, economic, and international elements as well as the technology of the situation." If this was the aim, it seems to me that there was an important omission. For example, the problem of population growth is not mentioned anywhere in the summary of workshop recommendations. It is inconceivable to me that one could argue that this is not an important part of the long-run energy problem. In addition there are frequent recommendations calling for government intervention of one kind or another, but there is no explanation or even seeming awareness of the basic reasons why the government should intervene. What is it about the workings of the market that calls for so much government intervention? If the need is due to market failure as a result of lack of information by the

consumer or to excessive energy concentration then wouldn't it be better policy to concentrate on those problems directly and improve not only the energy situation but also the overall performance of the American economy as well? Furthermore, there seems to be little or no attention paid to the inter-relationship between government subsidies for research and development, etc., and the distribution of income. If the government subsidizes research and development as is recommended on page 6-11, the chief beneficiary in terms of income distribution will be the stockholders of the energy firms which are subsidized. All research on the concentration of stock ownership indicates that it is heavily, heavily concentrated among upper income groups. But no mention is made here of combining such a research and development subsidy policy with a policy that reserves the patent rights from this subsidized research to the U.S. government in the name of the American people, as opposed to giving these monopoly patent rights to the subsidized firms.

Another way in which the total system is ignored is in the recommendations under "limit imports" on page 6-10. If we limit imports, and if petroleum products seem to be the cheapest energy source, and if domestic petroleum continues to increase in cost in comparison to the cost of international petroleum, then we will force ourselves into higher production costs than the rest of the world. This will have an important effect upon our ability to trade in international markets and upon our standard of living. In general insufficient attention appears to have been paid to the international arena. There is no mention in the recommenda-

tions of international policy. For example, what individual or concerted action should guide future U.S. policy towards the oil exporting countries? What is the likely future of the Arab oil cartel? What can the oil importing countries do to influence the future of that cartel? An oil economist such as Morris Adelman would have been useful in this conference.

It seems to me that too little attention was paid to the problem of the disposal of nuclear wastes generated by conventional nuclear power plants.

Frequent mention is made of encouraging the development of an electric car. Perhaps my poor knowledge of physics and engineering leads me astray here but it would seem to me that an electric car would be an inefficient use of energy since there must be considerable energy waste involved in using resources first to produce electricity and then to use the electricity to power the car.

In the discussion of transportation alternatives on page 6-11 no mention is made of the role of subsidies encouraging the extensive usage of autos. Neither is mention made of the various subsidies that exist to encourage urban sprawl, which also increases energy use.

Although I feel that the above shortcomings do detract from the quality of the recommendations, nevertheless there is still much of value in these wide-ranging and far-reaching suggestions.

6. What aspects of the portable energy problems of the nation were not properly addressed?

This question was dealt with in my discussion of question 5.

7. What aspects of the nation's portable energy problem will deserve special research in the near future?

As is no doubt apparent from the preceding discussion, I feel that a most important area for future research is the subject of interrelationships between the nation's portable energy and other energy problems, environmental protection, the distribution of income, and the efficient performance of industry. There is a danger that with so much concern being voiced over the energy problem that policies to deal with energy will be enacted in ignorance of the effects that these policies will have upon these other areas of American life. The recommendations of these study groups, the proposals of the Nixon and Ford administrations, and the suggestions of many other well-intentioned people both in and out of public office only serve to increase my apprehension in this regard.

In spite of the foregoing reservations, I feel that the merits of this experiment far outweigh any shortcomings. This approach has much to recommend it, and if it is replicated in the future, what was learned from this initial effort should prove valuable the second time around.

ATTACHMENT 11.

Review of Portable Energy Assessment  
Workshop Proceedings Report

Submitted by:

Sheldon Olson

### Summary

Overall, the objectives of the project were quite sound and feasible.

The execution of the conference in terms of facilitating productive dialogue seems to have been quite successful. The balance of the participants was rather good with the critical omission of "public opinion." The conclusions and recommendations of the work groups are too cryptic as presented. Future research might well include a national survey and forum (see #7).

1. "How valid were the workshop objectives (pages 3-1) in terms of feasibility, relevance, concept, applicability etc. ?"

The idea of tapping comprehensive sources of information, attitudes and opinions is as appealing as it is difficult to achieve. The project, from the accounts given, was more successful in tapping attitudes and opinions than information. Along these lines the time allocated to the project and the lead time allowed participants made the goal of obtaining comprehensive sources of information less feasible. I know this is nit-picking, but the word "comprehensive" is somewhat bothersome in this context. In terms of what was accomplished a better description is "strategic." Even with this more limited goal one "strategic" source, strategic especially in light of the decentralized proposals coming from the present National administration for energy and monetary restraint, is the person on the street. I will have more to say of this later.

The second portion of the overall objective -- that of coming up with agreement on recommendations and anticipated problems and a clarification of differences -- is crucial, relevant and, judging from the accounts given, largely reached. The interjection of facilitators, and facilities for communication as well as the structured tension should have been quite useful in obtaining this goal. Again I will have more to say of this below

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2. "How Well were these workshop objective met?"

By-in-large these objectives were largely met. It is somewhat difficult for this reader to say in great detail how the process might have fallen

short due to a lack of information on how the sessions went, what alternatives were considered, how resolution was reached. In part my lack of ability to evaluate how comprehensive the sources of information were is due to an ignorance of the "experts" chosen. On the one hand their titles suggest that they were indeed chosen from a number of widely divergent fields and with some prestige within those fields. To this extent, and with the reservations suggested in the report, and the added reservation of the omission of the public opinion contingent, I would say that indeed a wide range of perspectives should have been present.

As stated above, the way in which the conference was structured seems to have been excellent for the expression of differences and the possibility of resolution.

Material sent out might have included more by way of information (articles etc.) even with the reservations expressed on page 3-15 concerning the lack of preparation on the part of participants. (More consideration might be given as to how to get more thorough participant preparation next time.)

The articles provided might point to the central issues involved. This ties in with the suggestions noted on page 3-13 regarding the clarification of the objectives of the conference. If nothing else participants could read them on the plane ride to the conference. Along these same lines you might have brought the chairmen together a day or so early. In this manner, least the coordinators of the groups would have had a more thorough feel for the thrust of the conference.

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3. "What are your opinions of the philosophical basis of the workshop approach and of the methods used to carry out these principles (pages 3-1 through 3-13).

As a mechanism for generating thought on a relatively unexplored area, the workshop technique seems quite useful. Structuring in "facilitators" of communication in the form of participants, informal settings and feedback is sound. Also the notion of tension as a generator of synthesis and closure is good. Such tension and resolution promises much by way of reaching the desired objectives. Not having access to the larger setting of the conference I can only speculate that it worked out well. Judging from the reports of the conference this seems to have been the case.

The idea of first setting up the groups on the basis of consensus and then introducing the probability of divergence by a second structuring of groups is good. It should have allowed for the formation of initial opinion, attitude and information consensus in a rather supportive atmosphere, thus minimizing the impact of the lack of prior preparation. By then confronting differences with one another the conference should have further enhanced the productivity of debate.

It seems, then, that the strategy of implementation appears in theory and outcome to be quite good. The encouragement of far-out ideas as foils for discussion, the facilitators of communication, and the pattern of consensus based discussion followed by dissensus all should have led to a successful outcome.

On the other hand, the conference seemed to have a built in assumption that elite members exhaust the major elements of society. This is partially reasonable in that public opinion is in some measure shaped by these segments. Nevertheless, the person on the street, the one which the present decentralized approach to energy conservation is focused, should have been more directly represented. To a degree the members chosen are also consumers and thus this perspective was not altogether neglected, but there may be important differences.

Along these lines you may want to contemplate some follow-up survey study. The focus might be on anticipated reactions to various alternatives. This of course would have all the many problems associated with opinion polls related to anticipated voting patterns etc. Such a study would, however, give some sort of baseline information which could prove quite useful in light of the voluntarism currently being relied upon. It would also provide some basis for arguing for either the "Mansfield" proposal for controls or the administration's policy of jawboning. Another proposal for incorporating public opinion and at the same time providing information on the importance of the issue would be a nationwide televised "town meeting" patterned after the present program on PBS. I will have more to say of these alternatives later.

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4. What is your opinion of the qualifications and balance of the participants?

I am simply not in a position to evaluate the participants, other than to reiterate the limitations noted in the report and the omission of the "common man" noted above.

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5. What is your evaluation of the conclusions and recommendations of the work groups (Sections 5 and 6)

The conclusions of the participants are too cryptic in their present form to allow much by way of evaluation to the relatively uninformed reviewer. They are not useful as presented -- 5-14 and 5-15. Recommendations Ditto.

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6. What aspects of the portable energy problems of the nation do you feel were not properly addressed. (Particular emphasis should be given to your particular discipline in addressing this question).

The most obvious omission is the lack of non-elite, consumer input. Since these members of the overall scheme of energy consumption are going to have a major influence, this is a critical omission. In part this omission might have been due to the conference format of the project. Conferences are not tailored for the input of the public. Suggestions as to how this might be remedied follow.

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7. Are there any aspects of the nation's portable energy problem which you feel will deserve special research in the near future?

As suggested a number of times above input from the public is a must. As I envision such a project, and I have only given this a little thought, it would come in two stages, parallel to the organization of the conference. The first would be in the form of gathering information from the public in the form of opinions and attitudes. These might be gathered in the form of responses to a series of hypothetical concrete life situations. What would

you do if...? What would you do when...? etc. Now these, of course, bring the study face-to-face with the "what-we-say-what-we-do" problem and this frequently noted discrepancy would have to be taken into account. Various characteristics of the respondents could be included in the survey to anticipate variation along these lines.

Such a national survey could then form the baseline for some sort of public forum guided by the concerns and orientations expressed. This public forum might take the shape of a televised national town meeting similar to the present format on PBS. It might be a series of regional meetings followed by a national program. As conceived this (these) meeting(s) would serve a dual educational function -- education of the public as to what some of the complexities are, and education of the leaders as to what some of the individual concerns are.

Note on research interests:

I would be interested in participating in the collection and analysis of the national survey information outlined (very roughly) in number "7". Such a project would be best conducted in conjunction with national research pollsters such as the Michigan Center or NORC. Data collection and analysis would involve design of the instrument (2-3 months), data collection (2 months) and analysis (5-7 months).

Cost ?

ATTACHMENT 12.

REVIEW OF PORTABLE ENERGY  
TECHNOLOGY ASSESSMENT WORKSHOP

for

CENTER FOR ENERGY STUDIES  
UNIVERSITY OF TEXAS AT AUSTIN

REVIEWER

J. W. PORTER

REVIEW OF PORTABLE ENERGY  
TECHNOLOGY ASSESSMENT WORKSHOP

I. OBJECTIVE AND METHODS

The workshop objectives are valid as stated. The workshop might have progressed further toward solution of the problem, however, by proceeding immediately on the assumption that unlimited growth in energy consumption in the United States is intolerable and that limited, zero, or negative growth in per capita energy consumption is necessary. This, in fact, was one of the major consensus conclusions of the workshop (5-14) and in my opinion is the conclusion whose implementation is essential to the long range (maybe even short range) success of all the other recommendations.

It appears that the workshop objectives were met in most respects. From comments made by participants in their overall evaluation of the results of the workshop, it was clear that the opening of additional lines for interdisciplinary communication as well as additional lines for information exchange within disciplines was valuable. A wide variety of opinions and attitudes were expressed and recorded in the final reports. There was agreement on the identification of some key issues and a reasonable number of dissenting viewpoints.

The participants seemed about equally divided as to the usefulness of the scenarios. The scenarios did serve as a focal point during the "warmup" period of the deliberations, and they seemed to be more effective when they were used as suggestions rather than as constraints. The rather tight structuring of the workshop (tight time schedules, a fairly large

initial amount of data and suggestions, chairmen that were group participants rather than neutral moderators, and excessive participation by group "facilitators") may very well have prevented new ideas from emerging. However, the tight structuring served the purpose for getting things done in a reasonable length of time.

The participants were generally well known and knowledgeable representatives of their particular areas. There was fairly good representation of various elements of our society. Possible exceptions are social scientists, news media, and youth.

## II. CONCLUSIONS AND RECOMMENDATIONS

In the opinion of this reviewer, the major conclusion of this workshop is that unlimited growth in energy consumption in the United States is intolerable and that limited, zero, or negative growth in per capita energy consumption is necessary. The implementation of this conclusion is probably essential to the long range (maybe even short range) success of all the other conclusions. Any recommendation that calls for producing more domestic energy without at the same time calling for energy conservation is shortsighted.

After the preceding major conclusion, the following recommendations and observations of the workshop participants were judged to be the most important:

Continued economic expansion will produce major problems. Even the energy supplies required under the environmental scenario will be difficult to come by even by exploiting all sources and will produce major strains on environmentally sensitive areas. The most easily available



energy sources (except imported foreign oil) are just those that are most likely to produce environmental problems. The environmental, social, and economic costs of meeting these energy demands will be unacceptably high.

Conservation is the single most promising strategy for the United States; it will have more immediate impact than any other action. Conservation actions must be taken on a national level beginning with a no-waste ethic by government. Current energy consumption patterns must be changed. The dependence on petroleum imports should be reduced to about 5% of our total energy consumption.

Clean energy sources such as solar and geothermal should be developed. Solar energy is non-polluting and inexhaustible. Solar energy could supply about 20% of the energy needs of the United States by 1990. Large scale support should be provided for solar water and space heating. Private utilities should be allowed to go into the business if that is what is required to get the job done. Research and technology programs should be started now.

Even though a mix of social, economic, political, and technological actions will be needed eventually, the social and political issues must be identified and addressed first before any long range solution to the energy problem can be met. Studies need to be made of a restructured society operating under zero or negative growth in per capita energy consumption. Public and institutional decision makers must be informed of new ideas and progress in this area.

### III. SUGGESTIONS FOR FUTURE ACTION.

Two aspects of the problem deserve future special attention:

- (1) studies should be made of the kinds of restructured

society and the kinds of lifestyles that would be implied by limited, zero, or negative growth in the demand for energy and by extensive energy conservation efforts. These studies should be directed toward the following goals:

- a) identifying the most desirable restructuring
  - b) softening the problems that will be produced in some social and economic sectors.
  - c) emphasizing the positive aspects of the restructuring and communicating these to political, social, and economic leaders.
- (2) extensive research and technology programs should be initiated for developing new energy sources such as solar, geothermal and solid wastes. These programs should be started now even though their impact would be long-range.

Reviewer: J.W. Porter

Date: November 6, 1974

ATTACHMENT 13

REVIEW OF PORTABLE ENERGY TECHNOLOGY ASSESSMENT  
WORKSHOP PROCEEDINGS REPORT

P. S. Schmidt

Review of Proceedings  
Portable Energy Technology Assessment  
Workshop

P. S. Schmidt

1. How valid were the workshop objectives in terms of feasibility, relevance, concept, applicability, etc.

The objectives of the workshop, i.e. the identification and assessment of problems and candidate solutions for the maintenance of adequate portable fuel supplies through 1995, are certainly valid ones. The transportation sector is now, and will continue to be, one of the major energy consumers. Transportation is the heart of our economy and our social and political institutions, and it is obviously of vital interest to our nation to insure the supply of blood to the heart.

It is clear from the proceedings, however, that the workshop objectives were not clearly conveyed to the participants. Few of the group reports showed any degree of focus on transportation problems. This will be discussed in detail below.

2. How well were the workshop objectives met?

I feel the workshop objectives were not met at all. The lack of concentration on the specific problem with which the workshop was charged was, in my opinion, a very serious deficiency. Numerous studies have been carried out on "the energy problem" in general, and to a large extent the deliberations and conclusions of the work groups are a reiteration of much that has been said before, and supported with a

much sounder technical base than was available to the workshop participants. References 1 through 14 are only a few typical examples.

3. What is your opinion of the philosophical basis of the workshop approach and of the methods used to carry out these principles?

I think in principle the workshop idea is a good one. The idea of bringing people of diverse views and expertise together to attack a problem with broad implications is sound; I also strongly support the concept of forcing the work groups to commit a set of conclusions to writing. I do, however, believe that some improvements can be made in the modus operandi for the workshop that would increase its effectiveness.

First, the participants need extensive advance factual preparation. Obviously, energy is so broad a problem that it would be unrealistic to expect every participant to "bone up" on all pertinent areas. Suggested readings might, however, be distributed in advance, with some general ones going to all participants, and several specific ones going to specialists in the various disciplines. This kind of preliminary homework would make the workshop more productive, and I believe it would produce more knowledgeable and original discussion.

Second, the charge to the work groups needs to be clearly set forth, and some supervisory mechanism should be provided to insure that the work groups stick to the subject. I understand that under certain circumstances it is desirable to maintain a loosely structured situation in the interests of free and creative discussion. In the present case, however, I don't believe that this approach was effective.

I would like to propose an alternative approach to the workshop concept that would embody some of the points I have raised above. This might be called the "war games" approach.

This concept is based on the idea that social institutions in democratic societies basically act in response to outside influences (principally governmental actions and economic pressures) as opposed to operating principally on internally generated initiatives. The workshop teams would be assembled in "role groups" (e.g. Coal Mines Union Group, White House Group, Sierra Club Group, OPEC Group, etc.), each of which will try to act in response to changing situations in simulation of the social institution which the group represents. Clearly, the best choices for participants in the groups would be persons most knowledgeable about the various institutions, and each group should include (although not be restricted to) members of the represented institution. As an example, a professor of labor relations would be an excellent member of a labor union group, even though he himself had never been a member of that union.

To generate each alternative scenario, one group would follow a designated policy and would initiate actions. The remaining groups would act in response to these actions. The system would incorporate feedback in the sense that short (say one year) time increments could be taken as decision horizons, and the various groups could thus make successive decisions based on knowledge of the previous responses of the other groups. When the final time horizon has been reached, the overall scenario is complete, and the sequence of initiatives and responses is condensed

and distributed to all participants.

A general assembly of all participants would then be held to discuss the resulting scenario. Conclusions could be drafted by a Summary Committee composed of one representative from each group.

While the proposed scheme is considerably more complex than the approach used in the Portable Energy Workshop, it is attractive as a more realistic simulation of real-world decision-making processes. It is also conceivable that it could be carried out "long-distance" and over a period of time, with workshop participants meeting at a central location only for the summary sessions.

A workshop using the suggested approach would require a longer time than the approach used, and the number of possible scenarios would have to be limited. The results, however, would in my opinion be more meaningful.

Another improvement in the workshop, regardless of the approach used, would be the availability of a reference library and some technical resource personnel. Several of the participants felt that their effectiveness was limited by a lack of hard data and an inability to get it.

4. What is your opinion of the qualifications and balance of the participants?

The participants all appear (by title and affiliation) to be competent in their respective fields. The balance was good, although lacking in some areas. The political and youth sectors were mentioned in the report. I feel that some others were weak also. Only one labor representative was present and this is a crucial one, particularly with respect to coal mining. "Business" was represented only by big business,

and I think small business should also be heard. A person with a good knowledge of low-income problems would have been valuable, since energy shortages tend to impact most heavily on this sector. Lastly, a stronger international representation was needed, since energy problems over the next two decades will obviously be the principal driving force in foreign affairs, and conversely, foreign affairs will have a major effect on energy policy.

5. What is your opinion of the conclusions and recommendations of the work groups?

As a general comment, with the exception of Working Groups A-4, B-1, and B-5, the groups did not really address the subject of the workshop. Most of their conclusions and recommendations were reiterations of policy alternatives that have been discussed before. The problem with most recommendations of this broad-brush type is that they are simply too abstract to be of much value in establishing a real policy. Had the workshop been more focussed, I believe some hard-core recommendations would have been generated.

Group A-4 had some interesting observations that merit discussion. I agree with the group that military applications are a logical base for demonstration systems. This is true not only because the military is a primary consumer of aviation fuel, but because security of fuel sources is a genuine national security problem. Hence the nation will be willing to pay the price of research and development ventures that might be too high-risk for immediate commercial application because these costs are defense-related.



I disagree with the group's assumption that hydrogen is too long-term to be of interest, especially with respect to military applications. Liquid hydrogen is available essentially anywhere that electricity (probably nuclear-generated) and water coexist. A base of hydrogen-fueled bombers and missiles in Alaska would pose a military threat analagous to nuclear-powered subs and aircraft carriers. Hydrogen powered ships might also be a possibility. As a transportation fuel, hydrogen is optimal because of its high specific energy (cf. the decision to use hydrogen fuel in the Saturn boosters). I was most disappointed by the workshop's failure to discuss hydrogen as a portable fuel option.

6. What aspects of the portable energy problems of the nation do you feel were not properly addressed?

As evidenced by the above comments, I feel that hydrogen did not receive sufficient attention. This is a question with such far-reaching implications that it is probably deserving of a workshop itself. I expect that the social, legal, and environmental problems raised by the hydrogen economy concept will be on a par with those of nuclear power, and will be compounded by the fact that hydrogen will have to be generated by nuclear power, at least until solar electricity becomes competitive.

Another area that received only a passing mention in Group B-5's conclusion was the substitution of improved communication for personal transportation. This, again, is an area ripe for attention by interdisciplinary groups such as were assembled at the workshop. The basic technology for a vastly expanded communications system exists, but the social, political, and economic problems of implementing such a system

have not been addressed.

The economic and social impacts of a literally "slowed down" society were not carefully considered by any of the work groups. This would have been a particularly appropriate question for Group A-5, since one probable effect of a major energy-caused economic dislocation would be a shift to less energy-intensive (and slower) transport modes. A historian or two would be helpful in addressing this question.

I believe there was a fundamental defect in the scenario for Group A-6 (International Disarray) in that world war was not considered as a probable outcome. The oil issue is potentially the most dangerous source of international conflict that we have ever faced, and I find it quite conceivable that we could go to war over the problem. The scenario given the workshop participants was, in my opinion, naive, and the work group did not question it.

7. Are there any aspects of the nation's portable energy problem which you feel will deserve special research in the near future?

I feel that the two technically-based options mentioned in 6 above (i.e. hydrogen and communications) deserve special attention as "research", and the "depression" and "war" scenarios certainly deserve the attention of policy-makers, since neither of these is outside the realm of believability.

Both the hydrogen economy and expanded telecommunications have received some attention from technologists (References 15, 16 and 17), but relatively little from other disciplines. They warrant an

interdisciplinary assessment.

I also feel that the role-playing workshop concept described in 3 would be an interesting experiment. Once the method were established for one problem, it would be applicable to a great variety of areas.

#### 8. General comments

As indicated in the above comments, I feel that the workshop fell short of its goal of defining problems and solutions relevant to transportation energy sources. At the same time, however, it clearly accomplished some other objectives that justify the effort.

First, it was a vital educational experience for a group of experts who, prior to the workshop, probably had little opportunity to see these problems from diverse points of view. It is difficult to assess how far-reaching an effect this kind of "sensitivity training" might have, but the impact on future decision making by the participants might be quite significant.

Second, a great deal was learned about the mechanics of operating such a complex inter-personal exercise. Future iterations on the workshop approach will certainly benefit from the experience gained here.

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ATTACHMENT 14

REVIEW OF THE PORTABLE ENERGY TECHNOLOGY  
ASSESSMENT WORKSHOP

C. Michael Walton

REVIEW OF THE PORTABLE ENERGY TECHNOLOGY  
ASSESSMENT WORKSHOP

by

C. Michael Walton

The objective outlined for the workshop participants was extremely ambiguous and very complex. Although the workshop participants were not well acquainted with one another, there was apparent mutual respect for the knowledge and expertise each represented in their field. Most participants had preconceived concepts of energy supply and demand, particularly in the portable energy area (once the term "portable energy" was defined). The concept of this workshop is an excellent mechanism through which an organization can sample attitudes, opinions, and information and benefit from the expertise represented by selected participants. The workshop provides the forum for interaction; which in itself is a noteworthy objective and a most difficult task to bring to fruition. A workshop of this order must have certain well mixed ingredients to succeed. Initially it must have a clear and concise statement of objectives. These must not be "goals" or "utopian" statements but realistic and viable. Second, the format must be well organized to insure interaction of work and

free time. It is important to provide for free time to stimulate the work session, but it must be arranged in such a schedule as not to deter from programmed work sessions. In other words, having a morning and afternoon off does not enhance an evening work session. A third requirement for a successful workshop is the selection of the participants. This is perhaps the second most critical element following the determination of the workshop objectives. The attributes of participants were well outlined in the Proceedings; however, it is very difficult to insure that these are adhered to without personal knowledge of the individuals concerned. As acknowledged in the Proceedings there was limited representation of the younger adults, elected officials, government agencies, and the news media. Their inclusion into the workshop would have provided an additional dimension, provided the individuals had the attributes essential for workshop interaction.

The participants must come to the workshop prepared and actively involved in the program. It was apparent from the documented proceedings and the comments from the participants themselves that they were not prepared to enter into the workshop program. Instead the initial session ("A") turned into a "warm-up" session. Much confusion resulted from their not being prepared and time was lost. Many participants blamed their lack of preparation on not receiving the workshop objectives, schedules, scenarios, and potential actions in adequate time to review it. Others became too involved with



the specific data provided in their respective scenarios and not with the "spirit" of the scenario. To many, the use of scenarios in a workshop of this type was a new occurrence, and they were not comfortable with it. It became apparent in reading the proceedings that the scenario served its purpose of setting the scene for the discussion. Many failed to realize the value of the scenario by discounting it on one hand, yet acknowledging a resumption of the discussion along its general theme, never realizing that such action was the actual intent of providing them with the scenario in the first place. I would suggest that the use of scenarios to initiate the workshop session was an asset to any success it may have enjoyed.

One major deficiency which seemed to surface throughout the workshop was the failure of the program sponsors to communicate the explicit purpose of the conference. The results in the form of the conclusion and recommendations (in addition to participant comments) clearly verifies this observation. It is difficult, if not impossible, to bring together divergent individuals and have them specify and detail issues with supporting data. Expectations should be limited to policy issues, research and development needs, and recommendation for programs and projects. It is evident that some participants were either dominated by their chairperson or intimidated by those participants possessing "facts." It may have facilitated the session interaction if the documents had been received in advance of the meeting in Monterey. This might have

provided enough time for all participants to have gathered together sufficient information to substantiate their positions. However, the providing of the documents in advance does not guarantee that the participant will read it or prepare his case. Again it was obvious that many of the participants were not as prepared to launch into a discussion as they should have been.

The objectives as outlined for the workshop were somewhat ambitious. Perhaps a more realistic objective would have been one which could have been more clearly stated and simplified to facilitate the program. Although the objectives of the workshop were relevant, I believe they were not feasible. It is very difficult to measure the degree to which the objectives were met. Certainly the success of the workshop was in the interaction which ensued, the R and D recommendation which can be defined from work session reports, and in the comments rendered by many of the participants. Since many of the participants stated that they were not sure what the objectives were; therefore they could not evaluate the success of the final product. Yet many stated that they gained insight into the major issues surrounding the portable energy problem. That in itself is a major accomplishment!

Philosophically, the workshop approach is a time proven mechanism. The concept of scenarios combined with small groups

of varying disciplines is an intriguing one. However, the selection of the participants and the role that each must play should be clearly understood and conceptualized prior to embarking on this approach. This is very important if the objectives are very complex and the participants unfamiliar with the details of the subject involved. In this case, with the misunderstanding of the objectives of the workshop and unfamiliarity of the participants with the purpose of the scenarios involved prior to embarking on the workshop sessions, it was very difficult to achieve the level of success desired.

The role of the facilitators in each session was not adequately defined, however, they could have provided more specific instruction to the chairperson and the session participants. There was some apparent opposition to the resource people provided to each work group. In one specific group eight TRW were involved at one time or another but never less than 2 or 3. When the TRW group was combined with at least one NASA representative and University of Texas participant, almost 50% of the work session participants were "insiders." It was most difficult to keep an active interaction going with continuous interruption by resource people.

Another area of concern seemed to be with the session chairperson. Some of the chairpersons were not completely briefed on their roles and the procedure of the session. Coupled with this same confusion over the objectives and scenarios, it is apparent that some sessions were not as effective as others. Also the policy

of retaining one chairperson from session A to session B may have influenced the similarity in the conclusions and recommendations of the session. I would not have anticipated that the groups would have essentially concluded with the same findings since the people involved did change. . In one specific case, the commonality of the findings from session A and B were directly influenced by the session chairperson. There was a tendency of the strong chairperson to inhibit and dominate many of the participants, thus deterring the interaction.

In terms of the qualifications in balance of the participants, it was evident that certain elements of our society were missing, as previously discussed. On the whole there was reasonable success in balancing the participants and their qualifications with the needs exemplified in the scenarios and the workshop objectives.

In terms of the conclusions and recommendations from the work group, I believe that they were very successful in identifying many areas of short term and long term action requirements. The similarity between the conclusions identified in session A and session B clearly indicates that it was difficult for the participants to separate the discussion that preceded in the testing phase of the scenarios from the discussion that took place in the supposedly heterogeneous grouping of session B. On the other hand, maybe there was a great deal of commonality between the varying scenarios and the discussion which was pursued in session "B." I suspect that in at least one

case the commonality of conclusions and recommendations of the work groups is indicative of the chairman and the procedure of retaining chairpersons from one group to the other. One recommendation might be to change chairmen for different sessions, thereby providing other people the responsibility for interaction and session results.

There were many recommendations made concerning portable energy and transportation. Emphasis was placed on the development of electric powered vehicles for use in urban areas. This would include not only private automobiles but also mass transit systems, buses in particular. One important parameter only mentioned in a peripheral sense was the consideration of transportation demand analysis. It is important when considering transportation and energy consumption to consider the causations of transportation/mobility requirements. One particular area which has considerable impact on energy consumption in the transportation sector is in the area of land use activity. Land use activities are directly related to transportation demand and energy consumption. There is a very definite need to study the interrelationship between transportation and land use to determine how land use activities can be planned in relation to the total transportation function. Land use policy and planning requirements may then be instituted to reduce or enhance mobility needs. A recommendation for additional research would be to analyze the interrelationship between land use planning and transportation demands. An

investigation of how transportation demands and mobility patterns can be favorably altered through the programming of land use activities is needed to enhance community goals and objectives. In turn there should be a requirement that all land use changes (i.e. development) or activities be evaluated for the affect that such alterations will have on transportation energy consumption. In this manner we can better achieve an optimum balance between transportation energy consumption and the demand for mobility through application of sound land use planning techniques. Obviously this is only one input into a complex set of societal and technical parameters associated with urban or regional planning; however, it is one of the areas where knowledge is needed before effective application can be insured.

Another area of needed research and perhaps a necessity for project and program planning is to require an evaluation of all transportation related activities in terms of energy consumption or energy effectiveness. Projects and programs may require an evaluation of the energy requirements associated with construction and maintainence of a new facility in addition to the operational aspects. User consequences have been used in highway planning as one factor in determining the relative benefit of a new highway or an improved facility. One user consequence is the automobile operation cost such as gasoline consumption associated with the highway. Perhaps this approach needs to be expanded to include other energy related consequences.

In light of environmental impact studies there is need to investigate the feasibility of a requirement to determine the energy impact or the degree to which that plan will impact the energy supply sector as well as the demand sector.

Another area of needed research and development is in the public education area. The public needs to be informed of the situation in which our society finds itself today in relation to energy supply and demand. There is a great deal of confusion, apathy, and suspicion which I suspect result from conflicting testimonies and the fragmented approach by which the public receives its information on this subject. There should be a concerted effort on behalf of special interest groups, governmental agencies as well as social and educational societies to provide insight into this problem. It is in the best interest of our nation that the citizens be informed of the situation in which we find ourselves. This would go a long way toward developing an constructive attitude toward conservation which is certainly a short term action. The lack of understanding by the public is needed on such topics as site location, safety, water conversion, coal resource development, conversion of waste materials to energy, the effect of deregulation of natural gas prices, and automobile emission standards to mention a few. A major education program is needed as a short term approach to energy conservation.

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PART IV  
SUGGESTIONS FOR FUTURE RESEARCH

## A. SUGGESTED RESEARCH EFFORTS

Listed below is a series of recommendations for energy-related research projects that might be undertaken by the National Aeronautics and Space Administration or other appropriate federal agencies. These recommendations were submitted by The University of Texas at Austin review committee described in Part III above. Although particular emphasis was given to portable energy fuel research, the nature of that problem and of the Monterey workshop were such that often broader energy aspects were inseparably intertwined with portable energy analysis.

1. A serious study is needed which concerns itself with the individual's assessment of the importance to him of being geographically mobile and of his dependence on the private automobile for that mobility. This study should seek to determine under what circumstances the individual will be willing to use mass transit and what are his frustration levels in terms of time, crowding, noise, distance, and purpose in transportation.

2. Decreasing energy consumption is likely to create changes in the traditional bases for social stratification ranking. What new stratification schemes might emerge if energy consumption is decreased? Will prestige and individual evaluations be based on race, ethnicity, education, or something entirely unforeseen?

3. A study is needed of the lines of communication and influence between decision-making elites and the public. When lines

of communication break down, the consequences are apathy or mass movements or both. Political sociology has much to say about the dynamics involved in information dissemination and opinion formation.

4. Forecasts of demand and supply of energy should be integrated through the nexus of price so that projections will be internally consistent. Both demand for and supply of any energy source depend on the price of that source; the market place acts to bring supply and demand into equality. An analysis of this type would help clarify issues of the type that were raised in the workshop.

5. When energy use is cut down, substitutes must be found. What will be the real cost of these substitutes? How can these costs be weighed against energy costs in terms of travel time, maintenance personnel, etc.?

6. Special attention to research on hydrogen and communications technology are needed. Both "warrant interdisciplinary assessment."

7. "Depression" and "war" scenarios deserve the attention of policymakers.

8. The role-playing workshop concept should be considered.

9. Social costs of technological changes should be investigated.

10. Research is needed on flexible means of transport to reduce portable energy requirements.

11. Ways to conserve energy in all sectors of consumption should be explored.

12. The adjustment of institutions to changes in energy supply and demand warrants study.

13. Technological advances should be scrutinized for their possible impact on climatological changes and on the whole range of the human habitat.

14. Additional research is needed to analyze the interrelationship between land-use planning and transportation demands. Land-use patterns can alter transportation demands and mobility patterns and, therefore, affect transportation energy consumption.

15. An evaluation is needed of all transportation-related activities in terms of energy consumption or energy effectiveness.

16. In light of the requirements of environmental impact studies for new projects, the feasibility of requiring studies to determine the energy impact or the degree to which a plan will impact the energy supply sector as well as the demand sector should be investigated.

17. A major public education program needs to be developed on energy conservation. This would help greatly in producing favorable attitudes toward conservation and even possible changes in consumption.

18. Studies should be made of the kinds of restructured society and the kinds of lifestyles that would be implied by limited, zero, or negative growth in the demand for energy and by extensive energy conservation efforts. These studies should be directed toward the following goals:

- a) Identifying the most desirable restructuring

- b) Softening the problems that will be produced in some social and economic sectors
- c) Emphasizing the positive aspects of the restructuring and communicating these to political, social and economic leaders.

19. Extensive research and technology programs should be initiated for developing new energy sources such as solar, geothermal, and solid waste. These programs should be started now even though their impact would be long-range.

20. Research is necessary to provide an international perspective of energy relationships in an increasingly interdependent world.

21. Questions related to the international situation need to be considered.

- a) Can any nation be self-sufficient in energy and, if so, for how long?
- b) Does a failure in one area have an effect everywhere?
- c) Are cooperative international ventures desirable?
- d) What will be the effects of energy problems on world stability and instability?
- e) What are the lineages between attainment of self-sufficiency in energy and the international, social, economic, and political systems?

22. Public attitudes should be determined and analyzed in two stages:

- a) Gathering opinions and attitudes from the public responses to a series of hypothetical and concrete life situations
- b) This survey would provide a baseline for some sort of public forum guided by concerns expressed in the survey. Possible formats include: televised national town meetings similar to present format on PBS; series of regional meetings followed by a national program.

23. There is a need for policy-oriented research based on plausible alternative futures in terms of energy and institutional mixes.

24. Relationships such as that between national energy consumption and GNP have changed more than once during the past, however, these relationships have not been adequately studied in terms of the plausible range of their modification. Moreover, they have been used as the bases of predictive tools even though their past behavior has not been fully studied or fully understood. Thus, up-to-date research in this area is desirable.

25. Better understanding of the mechanisms and transitions of rapid and deliberate institutional change to achieve energy goals is needed.

26. Special research of the nation's portable energy problems can be divided into short-term and long-term problems.

- a) In the short-term, the next 15 years, research might deal with the feasibility of nuclear-powered ships, synthetic fuel manufacture, increased man-miles per gallon, synthetic fuel manufacture from coal or oil shale, etc.
- b) In the longer term, power plant siting problems should be addressed on some basis other than one at a time. The use of "power parks" should be considered.

27. Research should be conducted on the advisability of supporting large pay-off projects as the breeder reactor, fusion, and solar for individual units as opposed to low potential projects as wind, tidal, etc.



28. One of the most important areas for future research is the subject of interrelationships between the nation's portable energy problems and environmental protection, the distribution of income, and the efficient performance of industry.

29. Since one of the most critical elements in meeting the energy problem is public acceptance that there is a problem, and since governmental credibility is not at present very high, the government might begin by:

Gathering baseline data on the effect on the supply of portable energy by non-industrial agencies, e.g., Federal Power Commission, Civil Aeronautic Board, etc. After these data have been verified, they should be made public. There is also a need to research the best method of regulating the allocation and the price of fuels.

30. Additional scenarios are needed for specific fuel usage patterns for petroleum, natural gas, coal, nuclear power, geothermal and other uses corresponding to different economic, political and social activities in the U.S.

31. Research is needed in the long distance transportation of energy from coal by means of electrical or diesel railroad, slurry pipeline with water or oil, gasification, liquefaction, and direct transmission through conventional overhead or super conductor systems.

32. Energy consumption requirements need to be developed for alternative electric transportation systems in terms of BTU per passenger-mile for electrified intercity freight and passenger railroads, electrified intracity buses and rail-rapid transit systems, and battery and fuel cell powered electric cars.

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33. Major research needs to be performed in the areas of air pollution controls for sulphur oxides, nitrogen oxides, particulate matter and trace metal emissions from coal-field power plants.

34. Overall natural environmental impacts need to be developed for energy source shift policies in terms of air pollution emissions, thermal waste heat discharges, water use patterns, and possible climate changes.

## B. RESEARCH PROPOSALS

The four detailed research proposals generated at The University of Texas constitute this section of Part IV.

### SOCIAL-DEMOGRAPHIC INFLUENCES ON THE DEMAND FOR AIR TRANSPORTATION

#### INTRODUCTION

Economic, social-demographic, and environmental influences are known to affect the demand for air transportation, but the specific kinds of influences within those broad categories on the demands for various components of air transportation (e.g., passenger, commercial) remain to be determined.

Changes in the major parameters influencing air travel will precipitate changes in patterns of such transportation, and analysis should be undertaken to identify those parameters and to establish quantitative indices between such parameters and the demand for air transportation.

#### OBJECTIVE

To identify major influences on the demand for air transportation and to establish quantitative means for projecting changes in that demand.

#### APPROACH

The study will focus on one point in time, 1970, among geographical units of the U.S., but longitudinal analyses will be adopted where feasible. The research will involve a synthesis of a number of proven analytical strategies in an effort

to extend work already begun in a manner that will have direct implications for policy formation in the area of air transportation demand. Specifically, the analyses will involve the following:

1. Extend earlier investigations of the economic, social-demographic, and environmental parameters begun in the scenario-construction phase of the NASA Portable Fuel Project. Parameters have already been identified which are assumed to impact the demand for energy consumption in general. These parameters will be empirically tested and emphasis will be placed on air transportation demand.

2. The overall model will follow the perspective of human ecology, that is, the study of ways in which population groupings adapt to demographic, technological, and environmental influences. A sufficient literature exists to aid in modeling these processes.

3. As noted above, the analyses will focus on geographical units of the U.S. in 1970. The form of the relationships between selected parameters and air transportation demand will be studied using regression analyses.

#### STATEMENT OF WORK

The contractor will provide the personnel, services, and materials required for carrying out the following specific tasks.

1. Identify specific measurements of demand for air transportation through a comprehensive review of the relevant literature and through consultation with the engineering and scientific specialists of the the Center for Energy Studies at The University of Texas at Austin.

2. Identify the components of air transportation demand, e.g., commercial, passenger. Ascertain the measurement of these components of air transportation demand.
3. Specify the most viable geographical unit of the United States for analysis. Depending on the data availability, these units may consist of counties, states, Standard Metropolitan Statistical Areas, State Economic Areas, regions, or some combination of these and other units.
4. Identify the broad range of economic, social-demographic and environmental influences which are major criteria for the demand in air transportation. This identification would follow from an intensive review of the relevant social science, engineering, technological assessment, and related literature.
5. Conduct correlation analyses to limit these parameters to those which are relatively statistically independent of one another. Issues of multi-collinearity will be addressed at this point.
6. Regress the revised list of parameters upon air transportation demand in general, as well as upon the components of that demand.
7. Identify the relationships most central to policy formation.
8. Provide a complete written report of the full analysis, specifying the magnitude and degree of change in the key parameters influencing air transportation demand.

## SCHEDULE

Six months: Identify the measurements of air transportation demand, as well as the components; specify the range of geographical units of the U.S. that could be analyzed; make preliminary decisions on unit to be utilized; gather initial data on social-demographic parameters. Prepare written report for NASA use.

One year: Execute regression analyses; examine the relationships identified; evaluate policy implications; prepare final written report.

## AN ANALYSIS OF INSTITUTIONAL AND ASSOCIATIONAL BARRIERS TO THE IMPLEMENTATION OF NEW PORTABLE FUEL SOURCES

### INTRODUCTION

The U.S., as a modern industrial society, is characterized by a high degree of efficiency and, at the same time, vulnerability. The societal specialization that facilitates production and distribution activities involves numerous components corresponding to a complex division of labor. These components, functioning in tasks critical to a given activity, can also effectively deter that activity. Depending on the component, the deterrence can take such forms as failure to finance, failure to innovate in research and development, work-stoppage, refusal to use or consume, or failure to adapt relevant legal-regulatory standards. The transportation function gives a prime example of vulnerability precisely because it underlies all other functions and characteristics of a highly mobile, technologically advanced society.

At a juncture in societal development when implementation of new portable fuel sources is critical for the continued optimization of the transportation function, it is vital to analyze and understand the barriers to such changes. These barriers may be sought under two major headings. First, institutional barriers arise when change confronts the complex of customary practices in a given area, such as in the political, economic, or educational institutions. Second, associational barriers form when proposed changes violate, or are defined as violating, the interests of particular groups, such as labor unions, corporations, or governmental agencies. Institutional barriers reflect the basic human

force which compels individuals to resist alterations in the social structure. Associational barriers refer more specifically to processes of equilibrating the material, and to a lesser degree the psychological, interests of various and often competing groups.

#### OBJECTIVE

The proposed study would identify institutional and associational barriers to specified changes in portable fuel sources, and, on that basis, would analyse possible means for overcoming such barriers.

#### APPROACH

Effective implementation of changes in specific energy situations involving new portable fuel sources can come about only by considering the barriers to those changes. Such a study will provide knowledge toward overcoming initial barriers in addition to developing insight regarding the consequences of specific changes. The study would involve the following procedures.

- 1.. Development of a descriptive system model of critical components in the portable fuel area.
2. Application of that model to identify and describe barriers to changes in portable fuel sources.
3. Verification of the barriers tentatively described through extensive interviewing with individuals from labor, industry, government, and the general population.
4. Assessment of requirements to overcome the verified barriers.
5. Development of forecasting procedures on the basis of the system model to identify possible (and probable) consequences of



implementation of the stated changes for each of the population sectors interviewed.

#### STATEMENT OF WORK

Following the general approach stated above, the contractor will provide the personnel, services, and supplies to undertake the following specific study tasks.

1. Identify and describe the major kinds of new portable fuel source situations.
2. Identify the institutional and associational components relevant to the portable fuel area, modifying as necessary to then describe specific new portable fuel situations.
3. Define the bases of opposition flowing from these components to the proposed changes.
4. Provide a system analysis of the interrelationships of components in the portable energy sector. This system analysis should be sufficiently complete to allow continued projections for additional new portable fuel source situations after the present project is finished.
5. Outline incentives and alternatives for implementing changes in portable fuel sources.
6. Discuss component-specific implications of the proposed changes.

#### ESTIMATED SCHEDULE

Six months: develop the system model, including identification of key portable fuel source changes, identification of critical components, and tentative descriptions of major barriers.

Prepare a written report describing institutional and associational influences relevant to the portable fuel sector.

Twelve months: identification of barriers on the basis of interviewing; analysis of the interrelationships among components; identification of incentives and alternatives; discussion of implications of specified changes; detailed reporting on the system model to provide access for continued analysis. Prepare final report with appended interview information.

## SPECIFICATION FOR THE PRODUCTION OF ALTERNATIVE SCENARIOS BY SIMULATION

### INTRODUCTION

The Production of Alternative Scenarios by Simulation (PASS) method, which utilizes a technique similar to war gaming, would be used to generate predictions of possible sequences of events resulting from the adoption of a given governmental policy with respect to energy. A simulation team consists of a number of individuals, each an expert in a particular area expected to have a significant influence on the course of events (e.g. labor, legislative affairs, the voting public, science, etc.) plus a team of coordinators, also representing a broad base of backgrounds. The individual experts might be geographically dispersed, while the coordinating team must be based at a single location.

A scenario simulation would be started by defining a set of initial conditions for the "society" (i.e. economic conditions, fuel supplies, employment, social stratification, etc.) and a set of constraints that will govern future decisions. The latter will be established by the particular policy being evaluated. A perturbation on the initial conditions (say a tax increase) will be introduced and each of the experts will respond by predicting the reaction of his particular interest group over a short time horizon (one or two years). These changes will be collected by the coordinating team and consolidated into a new set of initial conditions for the next time step. The process

is continued until the ultimate time horizon for the scenario is reached, and the coordinating team documents the complete scenario.

The process described above may be carried out over a long period of time and without formal meetings of the participants. When the scenario is completed, however, the participants will meet in a workshop session to review the scenario and to consider what alternative courses of action they might have pursued given the hindsight provided by the exercise.

#### OBJECTIVE

To test the workability of the simulation approach for energy-related scenario generation.

#### APPROACH

1. The specific energy situation to be simulated will be identified and defined.
2. Two independent simulation teams will be selected with members who represent industry, government, and other groups involved in the situation as defined in 1.
3. These teams will work simultaneously on the generation of a limited number (one or two) of scenario productions.
4. The scenarios from the two teams will be coordinated by the directing team, and differences discussed at a forum involving the two simulation groups.

### STATEMENT OF WORK

1. Coordinating team writes initial conditions, constraints and proposed perturbations.
2. Simulations teams are defined by identification of the groups which would have decisional influence on the energy situation studied.
3. Members of simulation teams are recruited. A meeting of all participants is held to formalize procedures.
4. Production of experimental scenario with alternative initial perturbations.
5. Workshop forum is held and final documentation produced.

### SCHEDULE

- 6 months: background research, definition of proposed energy situation with initial conditions and perturbations; organization of simulation teams; progress report.
- 3 months: simulation carried out.
- 3 months: results of simulation are coordinated and workshop held for the two teams; writing of final report and editing of team reports.

DELINEATION OF POTENTIAL SOCIETAL DISLOCATIONS  
RESULTING FROM EFFORTS TO  
ESTABLISH ENERGY INDEPENDENCE IN THE UNITED STATES

INTRODUCTION

There is enormous potential for social, economic, political, and demographic dislocations if the United States elects to mount a major effort to become self-sufficient with respect to energy production. The Center for Energy Studies at The University of Texas at Austin will specify the parameters most likely to be significantly impacted by a program such as Project Independence. Cross-impacts and direction of relationships will be specified. The work will utilize and extend existing analyses in delineating general and specific effects. A study designed to identify the significant parameters is necessary before meaningful research can be undertaken to estimate the magnitude of effects because of the tremendous complexity of the problem and because little in the way of systematic analysis has been done thus far.

OBJECTIVE

To analyze population movements due to changes in energy generating facilities in the U.S.

APPROACH

The approach will involve bringing together and synthesizing both existing analyses and some original studies of the energy

needs, productive potential and requisite delivery systems of the United States in order to predict the dislocations that can be expected to occur concomitantly with a full-scale effort to reach energy independence. At least six general questions must be addressed:

1. What are the current energy needs (by sector) of American society and what changes can be anticipated in the next two to three decades in energy demands?
2. What are plausible mixes of energy forms which can meet the demand?
3. What is the location of the required resources?
4. What are the capital and human resources necessary to develop these resources?
5. What is the nature of the delivery system required to distribute the additional product?
6. What is the nature of the dislocations that will occur as a result of a full-scale effort to develop and deliver the greater quantity of energy in an acceptable form?

#### STATEMENT OF WORK

The contractor will provide the personnel, services, and material required to carry out the following specific tasks:

1. Compile and compare existing estimates of current and future energy demand by sector based on reasonable cost and population projections.

2. Delineate a range of potential strategies and energy mixes for meeting the demand.

3. Based on information available from government and industry sources, identify as accurately as possible the location and extent of energy resources and reserves (oil and natural gas, shale, coal, fissionable materials, geothermal, and hydroelectric).

4. Specify the social, economic, political, and demographic variables that will be significantly impacted by an expansion of domestic production of energy such as:

a. The sectoral and occupational transformation of the labor force.

b. The potential for new industry.

c. The redistribution of population that will certainly occur in response to variation in economic opportunities.

d. The redistribution of service industry (including transportation and communications) that will follow the movement of population.

e. The growth and mode-shifts in transportation that may be required for efficient delivery of energy.

f. The nature of the political changes necessary to facilitate growth of domestic production.

5. Specification of the type of data required to make rigorous estimates of the magnitude of the dislocations and of the capital cost incurred.



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